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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

POWER FROM BLAST FURNACES.

In his recent presidential address before the American Electrochemical Society, Dr. Joseph W. Richards touched briefly upon the waste of power which is now going on at blast furnaces and coke ovens. About two-thirds of the gases given off at a furnace are used to raise steam for power and to heat the blast. For a furnace making five hundred tons of iron per day this is, on an average, about twenty-five hundred horse-power. If the gas used to develop this were used in a gas engine instead of under boilers, and that which now goes to waste was saved, it is estimated that there would be an excess of ten thousand horse-power over and above the requirements of this furnace itself. The investment required to develop this power compares favorably with the cost of developing water powers and is therefore not prohibitive. There are thus scattered over the United States, in many cases in very desirable locations, undeveloped powers aggregating over one million horse-power, the use of which would not cause any drain on our natural resources. This condition of affairs should not be allowed to continue, and, as the price of coal is always rising, it deserves an increasing attention from those in search of sources of power.

STEAM TURBINES.

Time and again attention has been called to the numerous power stations where steam turbines have been installed, but probably few realize the extent to which this prime mover is being used. A recent computation has placed the aggregate power of steam turbines in use, or under construction, or ordered, in different parts of the world, at over 500,000 horse-power, equivalent to ten times the output of the first Niagara Falls station. Of this total, the greater part will drive electrical machinery, marine engines coming next in point of power output.

Large Steam Turbine Sets.

The size of the turbine units has also increased notably. A contract was recently entered into with one of the large steam turbine manufacturing companies for four turbo-alternators, each to have a normal capacity of 5,500 kilowatts, but with a maximum output of 8,250 kilowatts, or about 11,000 electrical horse-power. These turbines will be not only the largest steam turbines ever made, but the most powerful single-cylinder engines of any type whatever in the world. Considering the output, the dimensions of these machines are almost insignificant. The turbines will be but twenty-nine feet long, fourteen feet wide and twelve feet high, the overall length of turbine and alternator being fifty-one feet nine inches. It is hard to conceive of a more compact prime mover than indicated by these figures.

THE RELIABILITY OF ELECTRICAL MACHINERY.

For the past fifteen years, during which the electrical industry has made such remarkable development, the efforts of electrical engineers have been directed not only toward increasing the mechanical efficiency while reducing the cost of construction, but also toward improving the reliability during operation.

In the Old Days.

In the old days when electric lighting and traction were novelties, more or less imperfect service was expected. When the car motor refused to run, there was perhaps a little grumbling; or if the electric lights went out, people lit the gas, said something about the unreliability of electricity, wondered what was the matter, and then forgot all about it.

A Good Record.

How great has been the change during these years, has been told again and again. Now, when a large station shuts down, the occurrence is rare enough to be telegraphed over the whole country. If an electric railway is tied up through some unavoidable contingency, the matter is talked of and discussed in the papers for days. The fact is, we are so accustomed to seeing the cars running and the electric lights burning, that we now expect them to be operating day and night almost as confidently as we expect to see the sun rise to-morrow morning. The layman can not appreciate all that is necessary to ensure continuous operation, but may possibly be struck by the statement recently made that the service of the New York Edison Company has not been interrupted for the past ten years, and the system as a whole has never been without current. A record any business might be proud of.

ETHICS OF THE TELEPHONE.

The object of all improved methods of transportation, communication, or other public utilities is to save the time and labor of the users, and it is the convenience and the comfort thus realized which make them so essential to modern business life. But it too frequently happens that an improved method, in whatever utility, affords opportunity for abuse. An instance of this and one which is rapidly becoming a nuisance, was discussed recently in a sensible editorial in the *New York Times*. This is the habit of calling up a busy man by the telephone and asking him to hold the wire until the caller is ready to speak to him. Generally, an office clerk makes the call and the person with whom the caller wishes to speak is under the necessity of holding the receiver to his ear until the caller finishes the matter he has in hand and is ready to talk. This, of course, is very nice for the person who calls, and it saves wasting his precious time, but only at the expense of time and good nature of the person who is called.

No Obligation to Hold the Wire.

Of course, one is not obliged to hold the wire when he is requested to do so, and, indeed, we know of busy men who make it a practice never to comply with this request. If they are asked to hold the wire, they do not hesitate to place the receiver back on the switch hook at once. Unfortunately, this plan is not as successful as at first sight it would seem to be, because when the person calling finds that he has been cut off, he is apt to attribute the action to central, and again sends his call, when the same performance is gone through again.

A Remedy Suggested.

The telephone is probably the greatest time-saver for the busy man that has ever been invented, but this practice of requesting him to do office boy's work for every one who desires to speak with him is coming to be a serious objection to the office telephone. The matter is one which is beyond the power of the telephone company to regulate, and it must be left to the subscribers. There should therefore be some understanding among the subscribers as to when it is permissible for one to call up another and request him to hold the line. Would not the following plan help materially to correct the trouble, and perhaps lead to a sensible understanding. Let it be understood that when Smith calls up Jones, either personally or through his clerk, he can not expect Jones to hold the wire unless the business to be transacted is for the benefit of Jones. To make the point clear, let us suppose Smith desires to borrow $1,000 from Jones. Smith then should not hang up his receiver, but should remain connected so as to cause as little delay in communicating with Jones as is possible. If, on the other hand, Smith has been requested by Jones to lend the latter $1,000, and he is about to reply over the telephone, he is then justified in sending in the call through his clerk to Jones, and asking the latter to hold the wire until he can speak with him.

Avoid All Unnecessary Delays.

Where both individuals are equally concerned, let the caller always stand ready to talk as soon as connection is made with the caller's office, and in all cases let there be no more delay at either end than is absolutely necessary. A little more consideration for the time of others, which time is just as strictly theirs as money or any other property, would much relieve the trouble. Smith should not call up Jones unless he is ready to speak to him, and in turn he should exact the same consideration from Jones and all others. When those who are addicted to this objectionable practice find that it puts them to additional trouble and loss of time, it will be abandoned, and strict observance of some such plan as that outlined above would seem to suffice for all other cases.

Other suggestions are invited.

INCOMBUSTIBLE PAPER.

Incombustible paper is the theme in a recent play produced in New York by Mr. Frank McKee, the well-known theatrical manager. The author is Mr. H. J. W. Dam.

Why is not incombustible paper an idea for the inventor? Paper of fine texture and non-inflammable would have instant use in the arts and industries. We believe attempts have already been made to manufacture this, but do not know of its being in actual use.

THE SHUNT MOTOR FOR MACHINE OPERATION.

Of the three types of motor which may be used for machine operation, shunt motor, induction and synchronous motor, the shunt motor possesses certain features of operation which in some cases makes its use desirable. The characteristics of the shunt motor to be considered in this connection are its constant speed and its good starting ability.

Commutators Not Necessarily a Disadvantage.

The commutator on the shunt motor is often considered a disadvantage, but with good design and a fair amount of inspection and care, this mechanism should give no trouble. However, the man in charge of the shunt motor should know something about its management and it should not be left to the tender mercies of every factory hand.

Starting Ability.

The shunt motor starts easily under full load, but certain precautions are necessary. The full voltage can not be thrown on the armature while the motor is standing still, as this action will certainly open all the circuit-breakers on the circuit if no other damage is done. A starting resistance is necessary and this should be of substantial construction but need not be expensive. There is a slight loss of energy in this rheostat, but as it is in circuit for a few moments only this loss is insignificant. The starting of a shunt motor is no more troublesome and no more inefficient than the starting of a cold steam engine, as in the latter case it is always necessary to heat the cylinders by live steam, and this not only takes a little time, but uses steam.

Constancy of Speed and Turning Effort.

A good shunt motor is essentially a constant speed machine. It varies but a few per cent from no load to full load, and this feature makes it particularly valuable for that class of factory work where constant speed is a necessity. The uniform turning effort is also an advantage, and it has been shown in actual use that the motor drive in cotton mills gives a better product due to this feature than the irregular action of engines and belts. There is less breaking of the threads with

the former than with the latter method of driving.

Speed Variation by Field Regulation.

While the shunt motor is a constant-speed machine, its speed can be varied easily. The simplest way of doing this is to vary the strength of the exciting current. This method is also efficient, but if the motor is to develop the same turning effort at all speeds, a larger machine is necessary than would be required if speed variation were not demanded.

Speed Variation by Rheostatic Control.

Another simple way of varying speed, is to introduce resistance into the armature circuit. This method does not decrease the turning force of the motor, but it is rather inefficient as a loss of energy proportional to the loss of voltage of the rheostat takes place. The method, however, is useful when slight changes in speed are desired.

Speed Regulation by Multiple Voltage System.

This last method naturally suggests a third. As the speed of the motor was varied by lowering the potential at the brushes caused by passing the armature current through a rheostat, if a lower potential is applied to the armature at once, the same effect will be produced without the loss of energy in the rheostat. This is nothing more than the multiple voltage system, though, of course, there must be as many different voltages as there are to be different speeds. This latter method changes the speed in steps, but a combination of this and the preceding methods will give a uniform change in speed.

Speed Variation by Changing the Field Magnets.

The method of varying speed by changing the exciting current acts by changing the strength of the magnets. This can also be accomplished by increasing what the electrical engineer calls "the reluctance of the magnetic circuit," that is by making the field magnets less responsive to the exciting current. One method of doing this is to withdraw the cores of the field magnets, which throttles, as it were, the magnetic field, decreasing its strength. This method gives a continuous change in speed throughout the full range of the motor.

Speed Variation by Voltage Regulation.

The speed of the motor can, of course, be varied by varying the voltage of the armature circuit, using a separate dynamo for that purpose, and in some instances this method is very valuable, but of course the speed of all the motors on that circuit will vary simultaneously.

Motor Drive Still Comparatively Little Used.

While the motor drive has found extensive application in factory operation, it still represents but a small percentage of the total power used in factories in this country. It is undoubtedly good practice in some instances to retain the belt drive and there may also be cases where the old method may seem desirable for new factories, but if factory managers were fully alive to the benefits which result from the adoption of motors in place of belts, there would undoubtedly be a more rapid increase in the use of the motor drive.

THE DESIGNING OF TELEPHONE APPARATUS—XXI.

BY W. A. TAYLOR.

Where a low-voltage cross is liable to happen, there are two forms of arrester with which to protect the apparatus, the fuse and the sneak current arrester. By low-voltage current is meant any voltage under 250. A fuse will act more or less efficiently with these voltages, but if it is the only protection there will be a number of coils burned out because a fuse of low enough capacity can not be made. A one-quarter ampere fuse is as low a capacity as is made, and more than half of these fuses will carry twice their rated current without blowing. It is impossible to state at just what current quantity any fuse will blow, and therefore it is a doubtful quantity. On the other hand, the sneak current arrester can be gauged exactly for the work it is to do. A current of one-quarter ampere may pass through the fuse and the drop which the fuse is supposed to protect almost indefinitely without affecting the fuse. The drop may, however, be heating up to the point of charring the insulation. Take, for instance, a current of 100 volts and a drop coil of 500 ohms. A current of one-fifth ampere would flow; not enough to blow the fuse, but enough to burn out the drop in a few minutes. Currents which are not of sufficient strength to blow the fuse, but which become destructive to the telephone apparatus when allowed to flow for some time, are called sneak currents. To prevent the destructiveness of these currents the sneak current arrester has been devised. This class of arrester consists of a resistance inserted in the circuit, of such dimensions that the heat due to a sneak current will cause the melting of a fusible joint. The joint is placed under tension or compression, so that the circuit will be immediately opened or grounded when melted.

Fig. 56 shows a diagram of a common form of sneak arrester, which is also called a heat coil. The two ends A and B are arranged so that they will slip into the forked ends of two springs. These ends are also the terminals of a coil D which is wound about the small copper or brass tube C. The tube C has a cone-shaped end and into this end the extension of terminal B is slipped and soldered with a low-temperature melting solder. The terminal A and the tube C are screwed into the hard rubber piece E and the whole is then covered by a sleeve F of rubber or fibre. The coil D is of German silver wire wound to the resistance proper for the protection required. Any dangerous current passing through this coil will heat the soldered joint, causing it to melt. The springs holding the heat coil will then separate and either open or ground the circuit, or both. The heat coil, when properly made, is an exceedingly efficient article. It will act both on the low-voltage currents and also on high voltages, lightning excepted. The solder which is used melts at about 160 degrees Fahrenheit. The following is a very good formula for the making of this fusible metal: Lead, two parts; tin, four parts; bismuth, seven parts; cadmium, two parts; total, fifteen parts.

The formula has been tested by the writer and gives perfect service. In making the alloy, precautions should be taken to prevent the oxidizing of the lead and bismuth, both of which oxidize readily and tend to change the proportions.

It is necessary to have the arresters proportioned to the apparatus protected. A heat coil which will protect a series coil of eighty ohms may not take care of a coil wound to 1,000 ohms. The average heat coil measures about twenty-five ohms. This coil will blow on one-fifth ampere in about forty seconds, and will stand 0.15 ampere indefinitely. This arrester will not protect the average coil wound to 1,000 ohms, when a current of 0.15 ampere flows at the same time the coil will be destroyed. In order to protect the higher wound coils a more sensitive arrester must be made. One wound to about forty or fifty ohms would probably take care of such high-wound apparatus. The arresters in such cases being of high resistance should not be placed in the part of the circuit used for talking.

Where central energy systems are used

it becomes necessary to reduce the resistance of the coil so that the current used in the circuit for talking and signaling will not blow the coils. Here it becomes necessary to have a coil which, in some cases, will carry over one-third ampere indefinitely. In the heat coil used in the Bell Telephone Company's central energy systems the resistance is 3.6 ohms. It operates on one-half of an ampere in 240 seconds, and must stand 0.35 ampere for three hours. On the Bell circuit a short-circuit on the lines will at times cause about a third of an ampere to flow, it is therefore necessary to have a coil that will not blow with the maximum amount of operating current. It is necessary in these systems to so design the apparatus that it will stand the current which the heat coil will stand. Here is a case where the telephone apparatus is designed to go with the protection.

Another form of heat arrester is shown in Fig. 57. There are but three parts to this protector. The resistance consists of a graphite rod C, and the terminals A and B. The rod C is first copper-plated on the ends and then the terminals are soldered on by means of fusible alloy. The advantages claimed with this form are simplicity and surety of action; there being two chances to blow, where the coil in Fig. 56 has but one chance. This latter form is very efficient. The principal difficulty in manufacturing lies in getting graphite of uniformly constant resistance.

Another form of sneak arrester consits of a coil of German silver wire embedded in wax. The heat of the current passing through melts the wax and allows the springs to fly back. The drawback to this form is that warm weather permits the wax to flow.

Fig. 58 is another form of heat coil in which the terminals A and B are connected by a spiral of German silver wire which is wrapped around the hard rubber rod C. The coil is placed in the circuit inflexure so that any bending of the rod C will cause the circuit to ground. This form had the fault that it would also bend in hot weather, causing the lines to ground.

In mounting the protectors in an exchange where there is cable, a fuse should be placed in the circuit at the outer end of the cable, the carbon arrester and the heat coils should be in the office. If desired a fuse may also be placed in the office, though that is not necessary except that the cable might in some way get crossed with a lighting or power circuit. With this arrangement the grounding of the line, due to a heat coil blowing or a carbon arrester breaking down, would immediately blow the fuse at the outer end of the cable.

Some companies have abandoned the fuse at the outer end of the cable and have placed the fuse in the office. It is doubtful whether this is good practice, for with the grounding of the circuit by the carbon arrester, or the heat coil, the line is left open and all the strain is placed upon the cable insulation. Should the

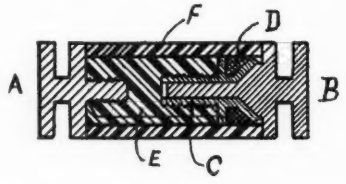


FIG. 56.

voltage be high or the cable have any weak points, a very bad burnout would result and place all the lines in that cable in trouble. As the weakest point is in the wiring of the cable pole, a disastrous fire is very likely to take place at this point.

The fuses should all be made so that when they blow, the arc can not communicate to the adjacent fuses or in any

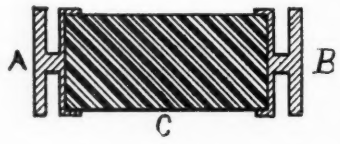


FIG. 57.

way cause a fire. There are fuse protectors now on the market so arranged that a heavy current will set fire to the whole row above and even set fire to the cable box. It is, of course, hard to design so that a fire can never result. A reasonable amount of care will result in fairly good results. All fuse mountings should be fireproof, either iron, porcelain, or

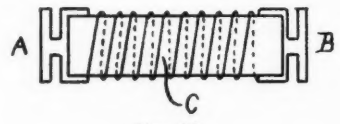


FIG. 58.

glass. It is better to have the fuse wire confined in a tube or between two folds of some non-combustible material such as mica.

One good form of fuse consists of a fibre tube inside of which is the fuse connecting the two terminals at the ends. One end of the tube is left open and in the middle is a wad of asbestos. When the fuse wire melts the heat causes the air to expand and in this expanding the wad of asbestos is forced out of the tube carrying any remaining bits of fuse wire and preventing an arc from forming. A heavy discharge of current will cause this to shoot like a pistol, especially with a heavy lightning discharge.

American Institute of Electrical Engineers.

The following resolutions were adopted at the meeting of the board of directors of the American Institute of Electrical Engineers, April 24, 1903:

Resolved, That the head of the electrical engineering department in each of the universities and technical schools in which local Institute meetings have been held during each year, be requested to select from the theses of each year's graduating class the one which, in his judgment, is of superior merit and is a valuable contribution to electrical engineering work.

Resolved, That a committee of three be appointed as a committee on theses to receive the theses which may be presented and to select those which are of superior excellence. The committee shall designate to the board of directors of the Institute those theses which, in its judgment, are worthy to be printed in full or in abstract in the transactions of the Institute.

Resolved, That theses to be presented to the Institute shall reach the secretary not later than July 15.

Proceedings of the Engineering Association of the South.

The current number of the *Engineering Proceedings of the Association of the South,* contains articles by Mr. W. H. Schuerman, upon some "Hydraulic Dimensions;" by Mr. W. T. Cutter, on the "Anthracite Coal Strike of 1902," and a description of the "Tullahoma, Tennessee and Lighting Plant," by Mr. Granbery Jackson. The latter is an interesting description of a small water power plant at which power is transmitted by means of three-phase currents at 10,000 volts, a distance of eight miles.

In metallurgy electrolytic solution processes are in use or on trial for the more valuable metals, such as copper and nickel. The reaction between chlorine and metallic sulphides at high temperatures brings the whole domain of sulphide ores under sway. Thus a sulphide, say argentiferous galena, is treated with chlorine, which gives off the sulphur as sulphur, which is condensed and sold, the lead uniting with chlorine, making chloride of lead. The silver is extracted by stirring with a little lead, and the fused salt is then electrolyzed, yielding pure desilverized lead and chlorine. The process is self-contained, yielding sulphur, lead and silver. It is especially applicable to mixed refractory ores which have been nearly valueless, though plentiful. These reactions have been proved on the large or ton scale, and there is no technical difficulty.

THE ECONOMY OF ISOLATED ELECTRIC LIGHT—EQUIPMENTS IN SMALL FACTORIES.

BY F. O. RUNYON.

It has become quite generally accepted among manufacturers who are keeping pace with modern improvements that the electric motor is at once the most efficient and desirable power transmitter which it is possible to employ. Especially is this evident where power exceeding twenty-five horse-power is required at points in the plant at some distance from the engine room. Losses in shafting transmission will usually exceed the losses in an electric generator, wiring and electric motor, to say nothing of the saving effected by being able to stop motors when power is no longer required at such points, thereby cutting down all consumption of power on account of transmission. In the case of belts and shafting these would still be consuming ten, fifteen or twenty per cent of the power used when machinery was running.

There are, however, numerous factories where the total power required is comparatively small and where the introduction of electric motors would effect little, if any, economy. The factory buildings are compact, the heavy machinery is located in close proximity to the engine, and when any portion of the works is in operation, the whole plant is running. It is to factories of this character that the following article refers. A small lighting generator and auxiliary apparatus are both economical and desirable. The manufacturer becomes in a small way familiar with the operation of an electric equipment, and before extending his plant, at some future time, he will look into the electric drive. In this way the isolated lighting equipment serves an educational purpose.

It is the purpose of this article to show the cost of installing and maintaining isolated electric light equipments in small factories. By small factories, the writer means factories using not more than 200 horse-power nor less than 100 horse-power in the production of their output, and generally occupying a total floor space not more than 50,000 square feet nor less than 25,000 square feet.

The classification is entirely an arbitrary one, but is based upon the writer's experience in one of the largest manufacturing cities in this country, where factories are found between these limits in great numbers.

Factories requiring 100 horse-power for the operation of machinery usually have a power equipment capable of producing 150 to 175 horse-power, and factories requiring 200 horse-power with an equipment capable of producing 250 to 300 horse-power.

The boilers are generally of the horizontal return tubular type and occasionally of the water-tube type.

The engines are of piston valve or Corliss type. In the piston type the speed will be found between 125 and 150 revolutions per minute and in the Corliss type between 80 and 125 revolutions per minute. The main line of shaft will be arranged to revolve at a speed of 150 to 300 revolutions per minute.

In a factory thus equipped, no increase in the wage account is incurred by the installation of an electric lighting plant, an engineer and fireman being already on the payroll. The surplus power in the factory engine is available, and while we must consider, in the regular way, the probable increased coal consumption by reason of the added load of a generator, it seldom reaches and never exceeds the amount apportioned in the following figures.

Having described the factory to which this article has special reference, it is now possible to proceed with the actual subject under treatment.

Number of Lights Required—A factory of 25,000 square feet of floor space may usually be lighted properly with 200 or 250 sixteen-candle-power lamps or an equivalent number of eight-candle-power lamps, and a factory of 50,000 square feet of floor space may be properly lighted with 400 sixteen-candle-power lamps or an equivalent number of eight-candle-power lamps. The use of eight-candle-power lamps is finding increased favor in factories where the nature of work is such that each operative requires an individual lamp.

The writer had recently to design a lighting equipment for a factory in which about 200 bench foot-presses were in use, located about forty inches on centres, and an eight-candle-power lamp for each operative was found much more satisfactory than one-half the number of sixteen-candle-power lamps.

Average Factory Use of Artificial Light—The average factory use of artificial light during a year is five months of twenty-five working days each, and for approximately two hours per day; making a total of 250 hours. This does not take into consideration any overtime work.

Lighting Equipment—Belted-type direct-current generators, 125 volts, designed to run at speeds from 600 to 900 revolutions per minute, may be driven from the main line of shaft, being thrown in and out of service by means of a friction clutch.

A slate switchboard, mounted in a suitable angle iron framework and equipped with voltmeter, ammeter, main switch, circuit-breaker, feeder switches, and voltmeter and ground detector switch, is required.

The wiring for lights will generally be run exposed on porcelain cleats or knobs, and the majority of the lights will be drop or pendent lights according to the nature of the work carried on in the factory.

Cost of Equipment—The cost of installing a first-class equipment for 300 or 500 sixteen-candle-power lamps is closely approximated in the following:

	300 Lights.	500 Lights.
Generator	$400.00	$550.00
Switchboard	175.00	210.00
Wiring	600.00	1,000.00
Belts, pulleys, clutch, etc.	175.00	250.00
Total	$1,350.00	$2,010.00

Annual Charges—The annual charges against these equipments, with interest at five per cent, depreciation at five per cent and maintenance at two per cent, are:

For 300 lights, $162.00
For 500 lights, 241.20

If seventy-five per cent of the total number of lights are in use for the period of 250 hours, the cost of coal for power required to drive generator will be:

For 300 lights — 3,250 kilowatt-hours, $65.00
For 500 lights — 5,405 kilowatt-hours, 108.00

The annual cost of lamp renewals for a 300-light plant will be about $30 and for a 500-light plant about $50.

The total annual charges are therefore:

	300 Lights.	500 Lights.
Interest, depreciation and maintenance	$162.00	$241.20
Coal, oil and waste	65.00	108.10
Lamps	30.00	50.00
Total	$257.00	$399.30

Comparison with Cost of Buying Current from a Local Consumer's Company—For a consumption of current not exceeding 5,405 kilowatt-hours per year the rate per kilowatt-hour for service from a consumer's company would rarely be less than ten cents per kilowatt-hour. On this basis the comparison is as follows:

Annual Cost with Factory Lighting Equipment.	Annual Charges of a Consumer's Company for Current.	Annual Saving Effected with Factory Lighting Equipment.
300 lights, $257.00	$325.00	$68.00
500 lights, 399.30	540.50	141.20

While it has been found in practice that the increased amount of coal consumed on account of a factory lighting plant, does not reach the amount set aside for this item of expense in the above calculations, it is, nevertheless, safer to use the minimum outlay on this account in making the above comparison.

The small lighting plant which is herein described may frequently be installed in cases where a proposition to rearrange for the electric drive would be deemed impracticable, either on account of the expensive first cost involved or the inability of the factory owner to forecast the future requirements of his business.

The Power Plant of the Invalides-Versailles Electric Railroad.

A Description of a Large French Generating Station.

By C. L. Durand.

THE generating station which has been erected at Moulineaux, in the suburbs of Paris, is one of the largest stations in France. It is used to supply current for the new Invalides-Versailles electric railroad which has been previously described, and also furnishes current for the Metropolitan line and for some of the surface traction systems. The station lies on the bank of the Seine and near the railroad station, which gives it facilities for obtaining a water and coal supply. The normal power of the station is 7,200 kilowatts, and it has a great excess of power over that which it actually supplies, so as to provide for the increased development of the different traction systems. The current is generated and supplied to the line at 5,000 volts, and is lowered at the points where it is used by substations. The current is also used for lighting the stations of the Courcelles-Champ-de-Mars steam railroad which passes through the city.

The main station building is divided into two parts and contains the dynamo room for the machines, with a boiler room in the rear which runs parallel to it. The extension cellar, which contains the piping, etc., lies below the high-water level of the Seine, and for this reason is provided with a water-tight flooring of armed cement, three feet thick, upon which rests the foundation of the engine and dynamo groups. The main dynamo room, of which a view is shown in the engraving, is of large size, measuring 360 feet long by 60 feet wide, and is well lighted by numerous windows along the side. It is provided with two twenty-ton electric cranes. The station contains nine main alternator groups which have steam engines of two different patterns, direct-connected to three-phase alternators of the Westinghouse type. These groups have a normal capacity of 800 kilowatts with a maximum of 1,100 kilowatts. The machines are placed in groups of three, and each of the intermediate spaces contains a pair of exciter sets. The latter are direct-coupled, driven by upright engines, and have a capacity of 125 kilowatts each.

Of the alternating-current groups, the six which are next the entrance are provided with engines of the Dujardin pattern, constructed at Lille. These machines will be observed in the rear of the engraving; they are triple-expansion engines with a pair of cylinders in tandem on either side of the alternator. The engines work at eighty revolutions per minute. The high-pressure cylinder is twenty-six inches in diameter, the intermediate forty-four inches, and the two low-pressure cylinders forty-four inches each, with a fifty-four-inch stroke. The governor acts upon the high-pressure cylinder, while the others have a constant admission. The cut-off is fixed at thirty-five per cent for the intermediate cylinder and fifty per cent for the low-pressure; that of the high-pressure is varied by the governor to give twenty-six per cent when working at 800 kilowatts and

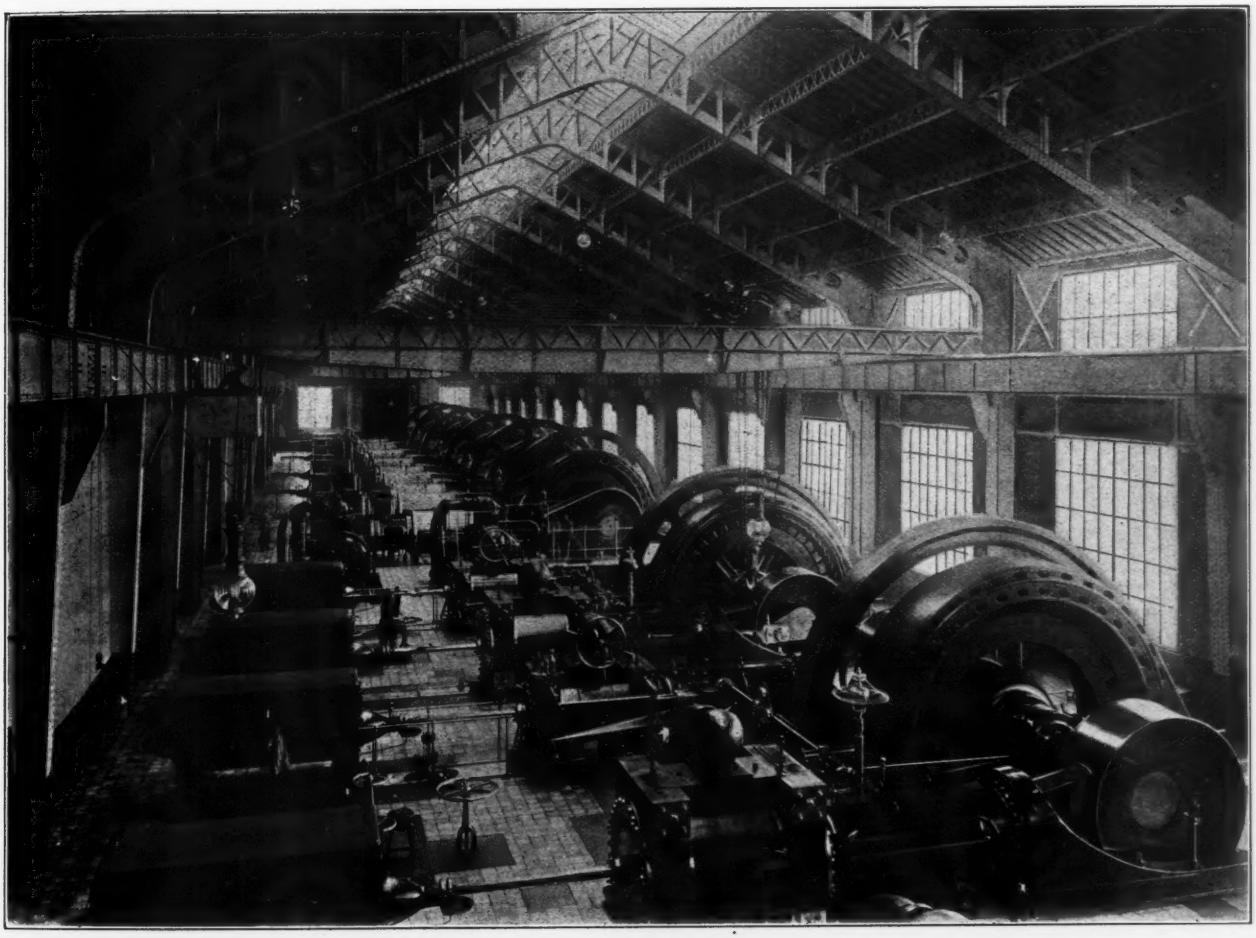
Boiler Room, Power Plant of the Invalides-Versailles Electric Railroad, Paris, France.

forty per cent at 1,100 kilowatts. A heavy flywheel is placed on one side of the alternator, as the inertia of the latter is not sufficient to give a good regulation. The flywheel is twenty-two feet in diameter and weighs twenty tons. The cylinders are provided with steam-jackets, and the steam is sent into that of the high-pressure cylinder before going to the engine, at a pressure of 140 pounds per square inch; for the others the pressure is reduced to seventy pounds. Each of the engines is provided with two condensers, which are placed in the cellar and also with the feed and discharge pumps, etc.

The engines used for the remaining three sets have been supplied by the Garnier & Faure Beaulieu Company, of Paris. These are Corliss compound engines, working at eighty revolutions per minute, with a high-pressure cylinder of twenty-eight inches, a low-pressure of fifty-five inches, and a fifty-two-inch stroke. The governor acts upon both cylinders and for a normal load of 800 kilowatts the cut-off is twenty per cent for the high-pressure and thirty-six per cent for the low-pressure cylinders. The condensers are placed upon the same floor as the engines, with one condenser just back of each cylinder, as will be noticed in the foreground. These engines are also provided with a twenty-ton flywheel, which is placed next the alternator.

The alternators, which are of the same type throughout, have been furnished by the Société Industrielle d'Electricité, which controls the Westinghouse system in France. They are of the three-phase type, working at twenty-five cycles per second. These machines give 103 amperes per phase and furnish 5,000 to 5,500 volts, which is that of the high-tension lines. The revolving field is laminated and has cooling spaces which correspond to holes cast in the flywheel of ten arms which forms the body of the field. The external diameter of the revolving part is fourteen feet three inches. The winding is of flat copper with forty-nine turns per pole. The exterior armature ring has the usual laminated form and its winding is laid in slots fourteen by forty millimetres, with three slots per pole and per phase. The conductors are held in place by fibre strips; each slot contains four insulated conductors which are surrounded by a mica covering. These machines embody the Westinghouse construction, which need not be described in detail. The total width of the armature is twenty-three inches and its weight is forty tons. The armature ring is fifteen feet seven inches in diameter over the active iron, or eighteen feet in total diameter of the casting. The alternators are started by a small three-phase motor of ten horse-power which operates a set of gearing. In the case of the first six engines the starting gear engages with the periphery of the flywheel, while for the others it is thrown on at the side of the wheel. The exterior armature is mounted on the usual sliding device for shifting it in order to afford inspection.

The fields of the alternators are excited at 110 volts and take a current of 175 amperes at no load or 195 at full load. The exciting current is furnished by four similar direct-current groups, which give 125 kilowatts each. These machines supply 115 volts and 1,080 amperes, working at 290 revolutions per minute; they are direct-coupled to upright engines of the Westinghouse compound pat-

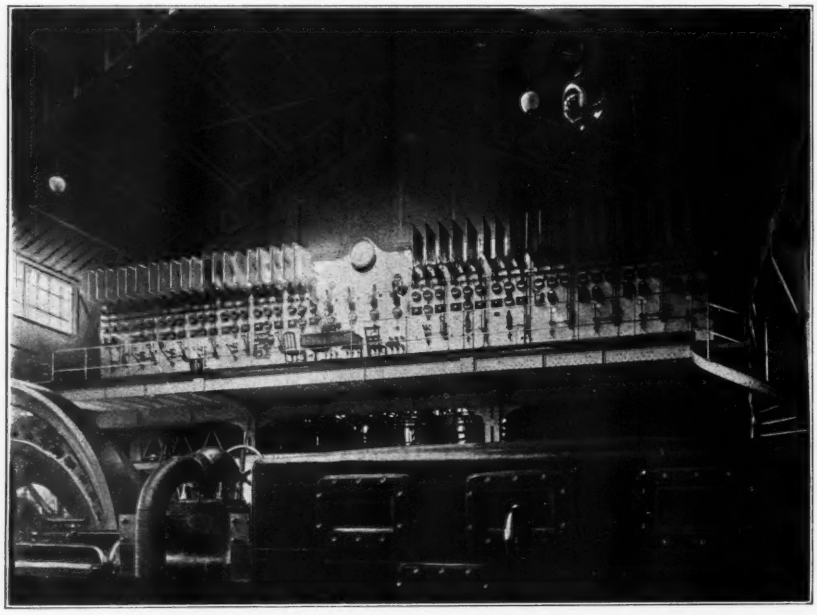


ENGINE ROOM, POWER PLANT OF THE INVALIDES-VERSAILLES ELECTRIC RAILROAD, PARIS, FRANCE.

tern. The engines give a thirteen-inch stroke with a thirteen-inch high-pressure and twenty-two low-pressure cylinder. The dynamos are of the eight-pole type. Besides exciting the fields of the alternators, the current is used for lighting the station and different shops, for the pumps and traveling cranes, etc.

The station is provided with a handsome switchboard which occupies the width of the building at one end. It is mounted upon a raised platform which is reached by two spiral staircases. The general appearance of the switchboard will be noticed in the photograph. It is connected with the machines by a set of cables passing underneath the floor. Below the main switchboard is a smaller board, which is used for the feeders. The main board contains eighteen marble panels, comprising four panels for the exciters, nine for the alternators and five for the feeders. The four exciting panels, which will be noticed in the centre, have a main voltmeter and a plug voltmeter which serve for all four machines. Each panel has an automatic circuit-breaker and a hand switch, with an ammeter and an exciter rheostat. The alternator panels are grouped on each side of the centre, and each contains a hand switch which is connected by a rod to the three-pole automatic circuit-breaker at the top of the panel. The instruments include an ammeter for each phase, a voltmeter for the field circuit, with two wattmeters and a field rheostat, besides the voltmeters. All the measuring apparatus is supplied by small reducing transformers. The arcing points of the circuit-breakers are separated by a set of marble partitions. The remaining panels for the high-tension feeders have a similar disposition. The feeders pass from the upper switchboard to a small board placed underneath which contains the meters for the various circuits. From here the feeders pass out to the main lines.

The boiler room, which adjoins the dynamo room, runs the whole length of the building and is forty-five feet in width. The boilers, which are of the semi-tubular pattern, have been furnished by the Meunier Company, of Lille. The series includes twenty-seven boilers, which are placed in a single range and separated by spaces into three main groups of nine each. There are three boilers for each of the engines. The grate surface of the boilers is 4.5 square yards. The boilers are supplied by the condenser water, which is taken at the outlet of the condenser by pumps worked from the main engine, using also a reserve set of two Worthington pumps, which are placed in the boiler room. The main steam piping runs above the boilers and a set of valves allows it to be divided off in case of accident or repairs. Connected to it are the pipes for each engine, which pass down behind the boilers and run through the cellar under the dynamo room, connecting with the engine through a drying chamber. The floor of the boiler room is five feet below that of the dynamo room and the exterior ground level. Along the side in front of the boilers runs a railroad track by which the coal is brought from the railroad station and discharged through a set of windows in front of the hearth. The cinders fall into the space below the boiler and are taken out below by a set of traps which open on to an underground passage. A set of small cars running along the passage receives the cinders and discharges them into a receiving pit from which an electrically operated conveyor takes them up and discharges them on the railroad cars. The smoke is taken off by a conduit which runs along under the boilers and leads to three smokestacks, one located in the building and the other two adjoining. The smokestacks are 160 feet high and ten feet in diameter at the base.



SWITCHBOARD, POWER PLANT OF THE INVALIDES-VERSAILLES ELECTRIC RAILROAD, PARIS, FRANCE.

The water for cooling the condensers and for the different purposes of the station is taken from the Seine by six pumps of the centrifugal type, driven by electric motors ranging from forty to sixty horsepower. The pumps send the water into a reservoir. The water is brought from the Seine to the pumps by conduits six feet high and five feet wide, from which it is elevated to the reservoir. The discharge water from the station is returned to the Seine by a conduit of smaller size.

The Moulineaux station has been built and is operated conjointly under the control of the Compagnie des Chemmis de Fer de l'Ouest (Western Railway), by the Compagnie Generale de Traction and the Société Industrielle d'Electricité.

A Convenient Supplies Schedule.

The Bureau of Supplies and Accounts of the Navy Department has issued a schedule of supplies combining the requirements of all the eastern navy yards at the present time, in order to give bidders the opportunity of competing for deliveries at all yards, as well as at one, at the same time and under one proposal. Heretofore the general practice has been to issue a schedule for each yard separately. By combining purchases as far as practicable it is hoped to secure a broader field for competition. All proposals issued by the department contain full information, specifications, and instructions to intending bidders. While they provide for a guarantee to accompany the bid to cover execution of contract in case award is made, upon furnishing satisfactory assurances, concerns are permitted to file a general guarantee covering all bids which they may submit; and thus avoid the formality of securing the execution of a separate guarantee for each proposal. Bids are opened and recorded at stated times at the Navy Department, Washington, the next opening of a general proposal for supplies being at noon, May 19. Blank schedules upon which to make bids may be obtained on addressing the purchasing pay offices of the Navy, situated in all the principal seaport cities, or the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

BOOK REVIEWS.

"Aide-Memoire de Photographie Pour 1903." (Memory Aid in Photography for 1903.) C. Fabre. Paris. Paper. 340 pages. 3¾ by 6 inches. Supplied by the ELECTRICAL REVIEW for $1.00.

This is the twenty-eighth volume of this photographic annual. It gives a résumé of the progress of the art, both in the preparation of material and in the technique of photography. It should be of value to all interested in the subject.

"Notes on Track." W. M. Camp. Chicago. Cloth. 1,214 pages. 7 by 10 inches. Many illustrations. Supplied by the ELECTRICAL REVIEW at $3.00 net.

This book is an elaboration of a series of articles published in the *Railway and Engineering Review*, of which journal the author is editor. This book treats of the construction and maintenance of railroad tracks from the standpoint of both the trackman and the engineer, the author believing that the thorough trackman must necessarily be able to comprehend some of the principles of engineering, and that a knowledge of some of the important details of track work is essential to the qualifications of a track engineer. For this reason, all problems in track construction are gone into with minute detail. The following list of chapter headings will show the ground covered by this work: Track Foundation, Track Materials, Track Laying, Ballasting, Curves, Switching Arrangements and Appliances, Track Maintenance, Double Tracking, Track Poles, Work Trains, Miscellaneous, Organization, Supplementary Notes and Tables. It will be seen from this that the work is very complete and should be a valuable reference book for all railway men.

"Modern Electrolytic Copper Refining." Titus Ulke. New York. John Wiley & Sons. Cloth. 170 pages. 6 by 9 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $3.00.

Although much has been written about electrolytic copper refining, it has been difficult to obtain reliable detailed information of this process. The managers of these works have adhered to a policy, long since superseded in some other industries, of considering their process a deep secret, and of discouraging visits and discussions by others engaged in the same work. In this book the author, who has had much experience in various parts of the world in copper refining, gives an excellent exposition of the art. The first chapter gives a brief historical sketch, and then describes methods and apparatus. This is somewhat detailed, describing methods of sampling and assaying; discussing the chemistry and physics of refining somewhat at length; describing methods of treating solutions and making bluestone and the method of treating slimes, and gives a résumé of modern practice in electrolytic works. Chapter II gives a full and illustrated description of copper refineries throughout the world. This contains many details, showing the variation in practice at the different works. Chapter III gives the specifications with general plan and detailed drawings of an American copper and nickel refinery, with an estimate of the cost of construction, the cost of operation and the annual output. Dimensions are given on these drawings. In an appendix at the back is a chronological list of patents, books and special articles of electrolytic copper refining methods and apparatus. This is complete and brought up to date.

"Storage Battery Engineering." Lamar Lyndon. New York. McGraw Publishing Company. Cloth. 382 pages. Many illustrations. Supplied by the ELECTRICAL REVIEW at $3.00.

The title of this book indicates the difference between it and other books on the storage battery, as the subject is taken up from an engineering standpoint rather than that of the manufacturer. The use of mathematics has been avoided as far as possible, and the new theories of electrochemistry are not gone into. The first part of the book discusses the lead battery in detail, the first chapter taking up the general theory. The author stands out for the simple idea of a direct conversion from lead peroxide and sponge lead to lead sulphate, the variation in voltage during charge and discharge being assumed as due to change in the concentration of the electrolyte within the active material. Chapter II considers the general requirements of a storage battery. Chapter III gives a discussion of voltage and its variations, and describes methods of testing to determine the condition of a cell. Chapter IV takes up the active material, and chapter V the electrolyte. Instructions are given for testing, purification and proper mixing of the materials, and chapter VI considers the proper quantity of discharge. Internal discharge, influence of temperature, variation and internal resistance, and efficiency are taken up in chapters VII, VIII, IX, X and XI. Durability and cause of deterioration are discussed in chapter XII; diseases and their remedies, in chapter XIII, and care and management, in chapter XIV. In chapters XV and XVI, types of Planté cells are described, and methods of formation. The Faure system is taken up in chapter XVII, and methods of repairing and supplying the active material in chapter XVIII. In these chapters each distinctive type of grid is illustrated by a well-known make. The remainder of the first part of the book discusses containing cells, assembling and installing, testing, and a table of energy equivalents. The second part of the book takes up the engineering problems, treating of auxiliary apparatus, systems and applications. The uses of batteries, whether for storage regulation of station output, or voltage compensation for feeder drop, insurance against shutdown, etc., are discussed. The end cell method of regulation is considered in detail. The various appliances necessary are described, including automatic switches. Chapters XXI to XLI inclusive, take up at length the various booster systems and show how each system is applied and operated. These give excellent descriptions of the shunt and series booster, the compound booster, the differential booster, the constant-current booster, and separately excited boosters. The design and selection of boosters and auxiliary apparatus are considered, and the application of the booster to two and three-wire systems is fully discussed. Chapter XLII takes up briefly alternating-current systems, and chapter XLIII the computation of battery capacity for any required condition. The use of line batteries which float on the load is explained, as well as the method of calculating for these. In discussing the question of plant efficiency, the conclusion is reached that in most instances the regulating effect and guarantee against breakdowns, are the chief factors which influence the installation of a battery plant. The last chapter in the book considers the specific case of an application of a battery to an isolated plant, showing how the proper size of battery is determined and giving estimate of cost. Throughout the book, concrete examples are used which assist much in making clear the rules laid down. The chapters are short and so far as possible each one is devoted to one particular topic, thus making reference on any subject easy. The typography is, in general, good, but it is to be regretted that the work of the engraver was not better; a number of the plates show careless and imperfect work. This, however, while unfortunate, in no way detracts from the great value of the text, which is the most complete and satisfactory that has yet appeared.

Some Problems in Space Telegraphy.

By Joseph B. Baker.

AMONG the small army of workers in the field of labor made so brilliantly attractive by Mr. Marconi, an amount of research is now going on that is probably only approached in magnitude by the contest for recognition and supremacy among telephone inventors at the time Bell's magneto telephone received such a memorable "boost" into commercial importance by the kindred invention of the carbon transmitter. With the advantage of the more complete knowledge of electricity and the increased mass of theoretical and applied precedents that obtain to-day, both the followers of Hertz in the realms of pure science and a large company of practicians of the type of Mr. Marconi are busily engaged in a competition to produce results in this fascinating field of endeavor. The student and observer of the widening domain of electricity, and the electrical engineer desirous of keeping informed on the whole progress of an art in which he practices a specialty, are put to it nowadays to follow even the main thread of the department, so full of incalculable promise, of signaling through space with no artificially installed communicating line, and by methods of propagation of dielectric stress exerted at right angles to a conductor, that were but yesterday generally unknown.

At the present time many competitive schemes are, in a measure, being disclosed through the issue of patents which, while not complete any more than space telegraphy itself is perfected, yet are indicative of the trend of the work of the several inventors. The names of the proprietors of the various principal systems of wireless telegraphy or telephony are in the minds of all readers of the electrical press, but the claims made for each system, at the implied expense of all the others, produce an effect of confusion and uncertainty in the mind of the reader, and also of the close student of the whole subject, who is desirous of estimating the value of the progress claimed here and there, and so of forming a just idea of the general net advances toward the commercial perfection of the whole art of "wireless." It is for the purpose of clarifying the subject a little, by making a brief presentation of some of the detailed problems yet unsolved, or only partially solved, that the writer submits the following remarks.

The most prominent at present—and, perhaps, in the last analysis, the most important—of these matters is the matter of tuning. Since in wireless signaling there is no line, but the action at a distance, on which the method of signaling depends, makes use of the medium, in space, common to two pairs of signaling stations, dispositions at the terminal apparatus alone must be depended upon to make such particularized and non-interfering use of the ether, as well as of the earth return, that a virtual "line" will be as truly and commercially realized as though established with poles and a length of wire. The medium that inundates all space must be selectively disturbed by manipulation of the electrical constants of the terminal apparatus. Electrostatic capacity and inductance, associated with ohmic resistance, are physical entities whose relations, in combination, mean the possibility of designing circuits that will favor the continuance of alternating electric currents of stated frequencies. Ever since this was recognized by experimenters attracted to the wireless field, they have taken up the idea of working with secret, non-interferable, selective or tuned oscillations that will penetrate to a greater distance than the originally used free oscillations of Marconi's first tests, and this has been a favorite claim and field of endeavor toward result. This special application of the study of harmonically alternating currents is a fascinating one. For, compare the elementary presentation of the means of transmitting and receiving free oscillations in Fig. 1, corresponding to the early Marconi station, and the means of transmitting and receiving oscillations more rigidly controlled in frequency, as indicated in Fig. 2, representing a possible arrangement of inductances and capacities applied to the antennæ at a pair of stations. In the former case the transmitting antenna itself, through the distributed inductance and capacity that it possesses inherent to its length and distance from the ground, determines which particular frequency is most favored in the group of various oscillatory currents that surge in it when the potential difference at its foot breaks down the spark-gap to ground. But the other frequencies present are not entirely inhibited by the electrical constants of the antenna, A; and hence, while a receiving circuit with simple coherer connections, as in Fig. 1, will be operated more positively or at a greater distance if its antenna, B, is of the same length and has the same constants as A, yet this state of affairs does not constitute tuning, for the reason that receiving antennæ of the lengths will have set up in them oscillating electromotive forces sufficient to break down the coherer of these stations, provided the group of series of free oscillations in A, or any one of the group, is sufficiently powerful to set up electromotive forces in B as an aperiodic conductor. In the latter case, Fig. 2, the transmitting and receiving antennæ are themselves parts of circuits in which an attempt is made to effect electrical tuning. On the one hand it is endeavored to limit the frequency of oscillation in the transmitting antenna, A, to the particular frequency most favored—"selected"—out of the composite discharge at the spark-gap by the electrical constants of that part of the tuning circuit drawn in heavy lines. To generate this frequency, and to give rise to a series of waves therefrom makes use of nearly all the energy of the transmitting circuit. On the other hand, also, a more sensitive receiving circuit is sought (shown also in heavy lines) by providing this with such electrical constants that the particular frequency set up by A, shall give rise at the receiving station to an oscillating electromotive force in a path, of which B is a part favorable to the continuance of a current of the said frequency and to the development of a persistent train of comparatively high successive electromotive forces that shall break down the coherer. To touch briefly on the mutual operation of the circuits shown, it may be said that the connections at the foot of A^1 comprise a source of potential difference delivered at the points *a b*, which breaks down the spark-gap connected across these terminals of the inductance, *c*, and of the derived circuit, comprising the inductance, *d*, and the distributed inductance and capacity to ground of A^1. If, now, the capacity in the antenna branch of this circuit is properly proportioned to the inductance branch, *c*, with due regard to the inductances in *d* and in the vertical wire itself, the flow of oscillatory current in A^1 and *d* will be nearly opposite in phase to that in *c*, and may be very large compared to the current oscillating at the spark-gap. Under these conditions, assuming proper construction of

inductances and avoidance of resistance losses in the circuit and the spark-gap, a powerful train of waves would emanate from A^1. In the antenna B^1, exposed by reason of its great distance from A^1, to only a minute segment of the wave front emanating from A^1, minute but persistently oscillating electromotive forces will be set up, and their persistence will be favored by the inductances of f and g; f being in series with the inductance and capacity to ground of B^1. Electromotive forces of the two halves of this series circuit will be in nearly opposite phase, and electromotive forces in g will be indefinitely large compared to those impressed upon the circuit, B^1 f g, by an impinging wave from A^1; so that a coherer in a suitable circuit connected to the terminals of g, would be broken down as a result of electromotive forces, operating in the vertical wire circuit, too feeble to do so directly.

It must be borne in mind that the circuits shown are simply illustrative of the possible species of arrangement in syntonized wireless signaling. After the mass of special work necessary to develop the proper construction of condensers and inductances for the generation of high frequency oscillations, and for the separate and no less special conditions at the receiving end for the transforming of the impinging waves into oscillatory electromotive forces, the ground work only of the full achievement of effective tuning has been laid. Failures to get the practical results expected after the most careful design of apparatus are found to be due to the fact that the use of the spark-gap brings in at the transmitting end the trouble of too short a train of waves by reason of the damping effect of the resistance of the spark-gap, if the balls are separated beyond a small fraction of an inch for the sake of reaching a receiving station placed at a greater distance by using the higher impressed electromotive forces due to the longer spark. There is good reason to believe that this difficulty will be overcome by improvements in the spark-gap, perhaps along the line of the new Cooper Hewitt interrupter, whereby not a rapidly decaying train of oscillations is produced, as in the present spark-gap of polished knobs separated by air, but a consecutive series of half-oscillations of maximum amplitude may be impressed upon the antenna. Assuming this to have been done, there remains the disturbing effect of the coherer or other wave conductor upon an accurate tuning of the receiving station, by reason of its high resistance when in a state ready to receive the signal. The auxiliary tuned circuits of Stone, inserted inductively as intermediaries between antenna and coherers, whereby the high resistance of the coherer is made to have no disturbing effect upon the tuning, and the use of the anti-

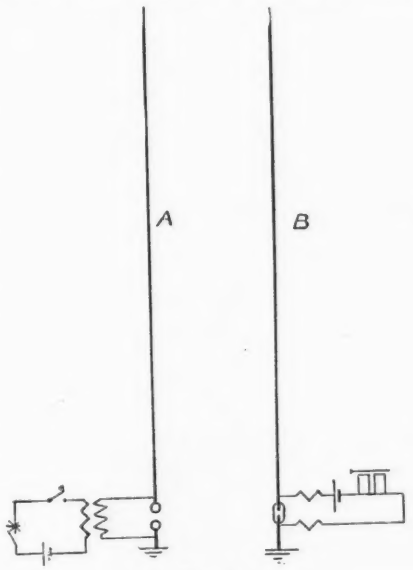


FIG. 1.

coherer of De Forest, and of the bolometer of Fessenden, are attempted remedies of this difficulty or evasions of it, whereby the theoretic accuracy of tuning of the receiving circuit may be realized. The failures that have been made to realize

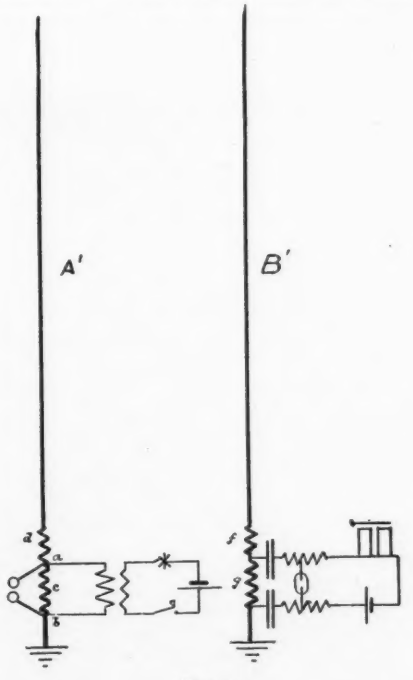


FIG. 2.

effectively tuned circuits, resonant through etheric waves when an ordinary air spark-gap is employed as the exciter of oscillations in a tuned or non-tuned transmitting circuit, may be roughly compared to attempts to excite a tuning fork to sympathetic vibration by setting into vibration a consonant fork, immersed in molasses, by sharp, infrequent blows of a hammer. The requisites of a successful apparatus to replace the spark-gap may be indicated by the approximate analogy of the practically operated method of exciting a secondary tuning fork by bowing or otherwise continuously sounding the primary consonant fork upon a sounding board in air.

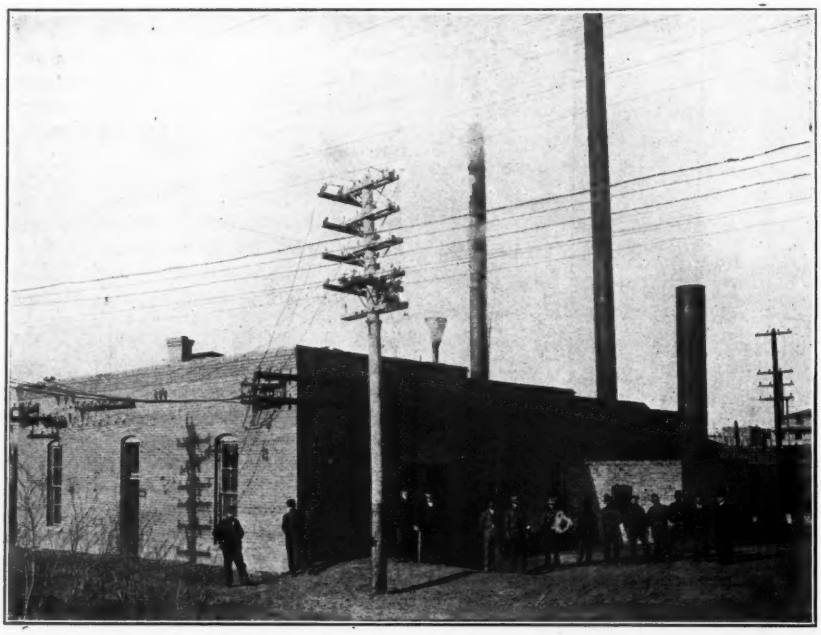
Recent important patent issues have been silent on the subject of attempts to direct the signaling waves. A successful accomplishment of this would mean the attainment of a kind of selectivity without tuning, and great economy of the power required by the sending antenna. In regard to the latter point, the need is already apparent in difficulties which are reported in making and breaking quickly circuits of high voltage and considerable power used in Mr. Marconi's long-distance signaling. Fessenden's wave chute is a device whose reported assistance to the efficiency of signaling apparently consists in providing an extraordinary large virtual area of contact with ground, the major axis of this enlarged area of contact being placed favorably to the propagation of waves in the actual direction of the receiving station. The considerations of merit in this scheme constitute a problem in the theory of potential losses in an electrical circuit, roughly analogous to the ground return losses in an electric railway system insufficiently equipped with return feeders. More directly comparable is the phenomenon that the loss by absorption of a light is apparently reduced by enlarging the luminous surface for the same candlepower. The luminiferous ether close to a powerful electric arc acts with apparently lower efficiency in propagating the light waves than the ether surrounding a combustion flame of the same total candlepower, but of much greater luminous area.

Speed of working, the point last to be mentioned but not least in importance, may be dismissed for the limits of this article with the statement that it is almost wholly a matter of the obtaining of persistent trains of waves, whereby the number of such trains for a positive intelligible signal may be diminished; and of dead-beat quality of receiving apparatus, whereby the signals, though shortened in length, and with correspondingly short intervals between them, will be preserved in distinctness. The self-decohering detector just heralded by the Lodge-Muirhead system—a steel surface continuously moving in apparent but not actual contact with mercury till electrical contact is established by the receiver wave—seems a long step in the direction of improved speed of working. With the coherer and its present experimental successors reduced in practice to a device corresponding in improvement to the modern siphon recorder used on ocean cables, as compared with the light-spot Thomson galvanometer that preceded it, space telegraphy will be far advanced toward a position of active competition with the present cable.

THE ALBUQUERQUE GAS, ELECTRIC LIGHT AND POWER COMPANY.

BY J. H. RUSBY.

The Albuquerque Gas, Electric Light and Power Company is one of the plants owned and operated by the United States Light and Traction Company, with headquarters in the Equitable Building, Denver, Col. The officers of this company are: J. J. Henry, president; C. K. Durban, vice-president; W. S. Iliff, treasurer, and T. B. Whitted, consulting engineer. Mr. Maynard Gunsul is manager of the gas, electric light and power company located at Albuquerque, N. M., and Mr. S. W. Dietrich is the superintendent.



THE POWER-HOUSE OF THE ALBUQUERQUE GAS, ELECTRIC LIGHT AND POWER COMPANY.

This plant is said to be one of the most successful operating installations in the West. The parent company, in addition to the Albuquerque Gas, Electric Light and Power Company, operates the following enterprises: The Electric Light, Gas and Ice Company, Tucson, Ariz.; the Electric Light and Gas Company, Baker City, Ore.; an electric light company at Sheridan, Wyo.; an electric light company at Rawlins, Wyo.; an electric light company at North Platte, Neb.; an electric light company at Silverton, Col. This company also operates the Western Gas and Electrical Supply Company, of Denver, Col. This concern carries all the supplies and machinery for the various enterprises, as well as handling all the outside business obtainable.

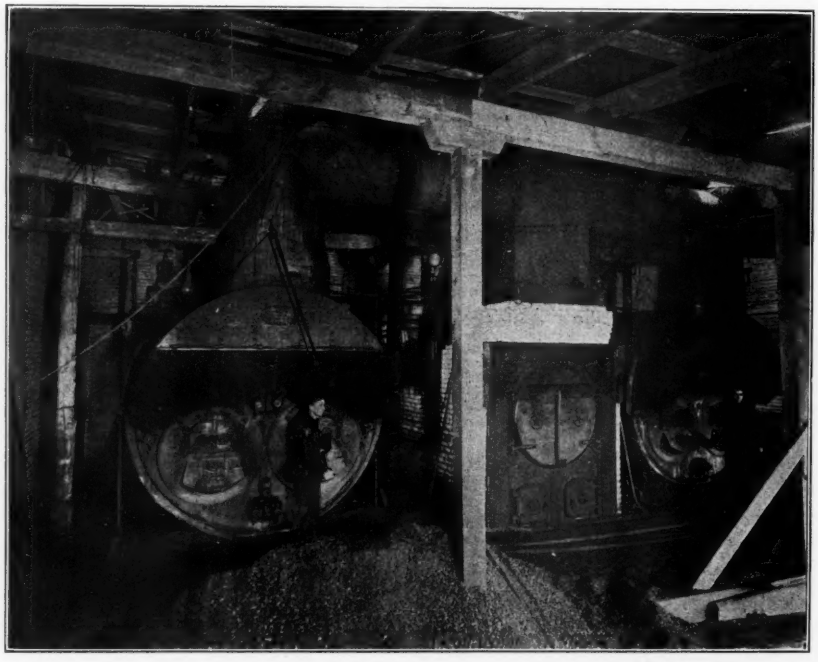
The Albuquerque plant supplies the city of Albuquerque with current for both power and light. The plant is at present undergoing a considerable extension of capacity, this being urgently needed to supply the increasing demand for power in various industrial enterprises of this rapidly growing western city. The plant at present supplies all the power for pumping purposes for the water supply, a sixty-five-horse-power 2,080-volt compensating induction motor being employed for this purpose.

The Rio Grande Woolen Mills employs in its plant about fourteen 440-volt induction motors, aggregating about 140 horse-power, for furnishing power to the various operations prosecuted there.

The Albuquerque Foundry and Machine Works employs five motors similar to the above, aggregating some twenty-five horse-power. There are also several direct-current motors already installed in an extensive planing mill, two coal and woodyards, and several other industrial plants.

It is the intention to supply the operating power to a projected trolley line for the city of Albuquerque, a description of which will be appended later. Negotiations are under way relative to supplying the United States Indian School at Albuquerque with current for power and lighting. This will be the first enterprise in this country to use electrical power from such a source.

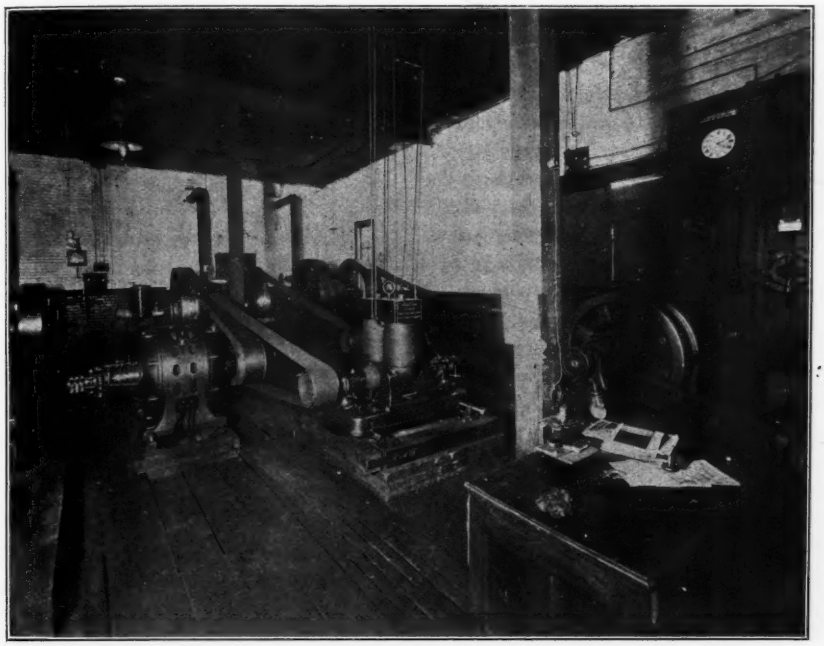
The generating station plant is situated on the easterly side of the Santa Fé Railroad tracks, opposite the depot. The boiler outfit consists of two 200-horse-power, marine-type Springfield boilers, heated by slack coal fuel. An additional boiler of the same type is now being installed for an extension of power capacity. An eighty-horse-power return tubular boiler is fitted to receive the exhaust gases of the furnaces, and to heat with these the boiler water, and as a precipitator to extract the impurities from the water before using. This method has been found very advantageous, and has



BOILER ROOM, ALBUQUERQUE GAS, ELECTRIC LIGHT AND POWER COMPANY.

effected a distinct and marked economy. The gases are forced by the use of a Sturtevant fan driven by a fifteen-horse-power motor operating at 230 volts.

The engine equipment consists of one 150-horse-power Ideal horizontal automatic spring-governed engine; one 110-horse-power and two 80-horse-power Armington & Sims horizontal automatic spring-governed engines; and an additional 500-horse-power Allis-Chalmers cross-compound Corliss engine will be installed as part of the extension now under way. This latter engine will be direct-coupled to a 333-kilowatt, 60-cycle, 2,300-volt General Electric generator. The present equipment of generators consists of two 30-kilowatt and two 20-kilowatt Edison direct-current 125-volt generators, and one 100-kilowatt and one 75-kilowatt General Electric, three-phase, 7,200 alternations, 60-cycle, 2,300-volt generators, together with one 60-kilowatt, General Electric, single-phase, 2,300-volt alternator.



ENGINE ROOM, ALBUQUERQUE GAS, ELECTRIC LIGHT AND POWER COMPANY.

The 100-kilowatt alternator is separately excited by a 125-volt direct-current generator, and the other alternators by current from the Edison direct-current machines, the exciting current being controlled by separate rheostats. With the exception of the Allis-Chalmers General Electric unit, these machines are belt-connected to the driving engines.

The distributing apparatus consists of the following: Two copper bus-bars properly mounted for distributing the output of the Edison direct-current machines, the current being controlled by four 500-ampere double-throw knife switches, one for each section, together with the necessary instruments for measurement and regulation, including two twenty-five-kilowatt transformers for regulation. All connections for the direct-current in the station are made with bare copper conductors.

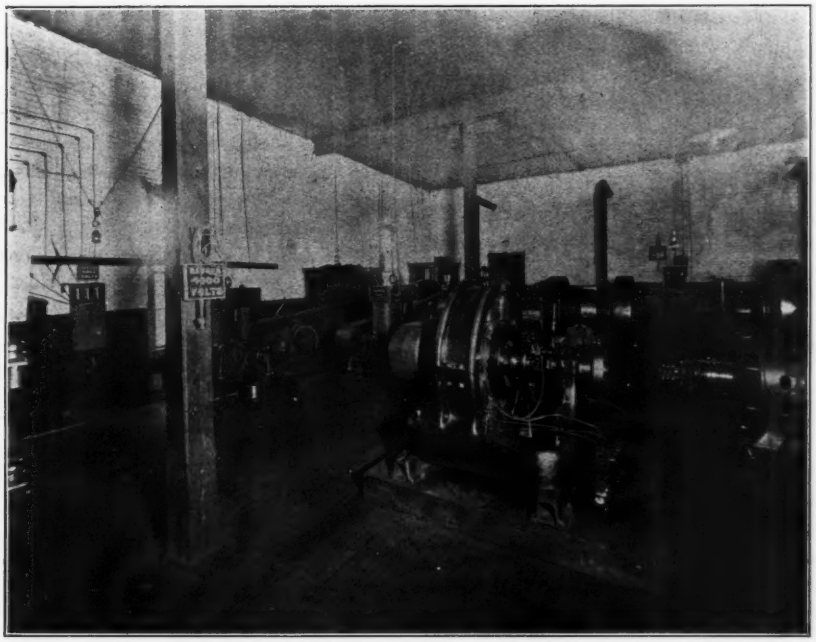
The alternating-current output is distributed from a two-foot gray marble panel-board, fitted with three quick-break three-pole knife switches and one three-pole oil-break switch. This is supplemented with standard measuring instruments for controlling the street arcs, of which there are 150 multiple-enclosed and fifty series-enclosed.

The average load of incandescent lamps is 4,000, there being about 7,500 lamps now in circuit.

The arc lamps are suspended from the street centres with Springfield Foundry and Machine Company's reels for raising and lowering. General Electric pole transformers are used for stepping down the street voltage for house use. Edison base lamps and sockets are used throughout the installation.

THE PROPOSED TROLLEY LINE.

The city of Albuquerque, N. M., is at present served by a horse-car system. This line is owned and operated by Mr. O. E. Cromwell, and was installed in 1883 as a first-class line, with an equipment of eight Stevenson cars. The line extends from old Albuquerque to the new town two miles. The project is to electrify the present line, the whole line to be equipped with new ties and sixty-five-pound rails and a new outfit of cars. An additional line will also be laid and built east and west, crossing the first-mentioned at right angles, and to be about three and one-half miles in length. Further extensions of the service are also contemplated, and an electrical installation is anticipated in the near future. The operating power will be purchased from the Albuquerque Gas, Electric Light and Power Company.



ENGINE ROOM, ALBUQUERQUE GAS, ELECTRIC LIGHT AND POWER COMPANY.

THE ARRANGEMENT AND CONTROL OF LONG-DISTANCE TRANSMISSION LINES.[1]

BY E. W. COWAN AND L. ANDREWS.

It would not be possible within the limits of this paper to deal with the question of long-distance transmission in a comprehensive manner. It is therefore proposed, after a general review of the points involved, to deal more fully with the regulation and protection of the lines by making certain suggestions with a view to the more certain maintenance of an efficient service.

GENERAL CONSIDERATION.

The Continuous-Current System ("Thury") is particularly applicable to water power installations as the highest efficiency of the line is at full load. There is the disadvantage of dangerous potential on the motors which limits the use to which they can be put. It is efficient and free from complicated switching gear, transformers, etc., but there is not sufficient elasticity with this system for general purposes.

Single-Phase Alternating—This system is still unpopular, chiefly because of the relative inferiority of the single-phase induction motor compared with the polyphase type. The difference in efficiency, starting torque, etc., between these two systems appears to be getting less, and it may be that the time is not far distant when the economy in copper and increased weight output of the generators with the polyphase system may not prove sufficient counterbalance to the greater simplicity of the single-phase controlling gear and lines.

Polyphase Alternating—This system generally in its three-phase form has been most generally adopted on long lines. At the present day it probably fulfils all the requirements of power work rather more efficiently than the single-phase system.

Pressure—The maximum pressure which has been actually in practical operation is 80,000 volts. The Standard Company of America has operated on one of its lines for two hours in adverse weather at this pressure without any trouble arising. There is no reason why this should be the limit of pressure as transformers have been worked well above 100,000 volts, and with liberal spacing of the overhead wires the electrostatic leakage can be sufficiently reduced. The capacity current increasing with the pressure must of course be reckoned with and, if necessary, compensated for by suitable reactance coils. It is with large powers and long lines that economy requires the adoption of these great pressures. There is no reason why a scheme should not provide for the supply being transmitted at a low pressure in the early stages of its career, and when the requirements of the situation justified it, the pressure could be raised merely by an alteration to the step-up and step-down transformer connections. According to Mr. Parshall 20,000 volts may be taken as the safe limit for underground cables. The cost of insulation and the capacity of the underground cable rendering the use of higher pressures prohibitive. There is a point in favor of high voltage for underground cables which should be borne in mind. Assuming the same energy transmitted by a cable, the heat energy developed at a fault is, from one point of view, inversely proportional to the square of the pressure. We consider therefore that the Board of Trade should allow greater energy to be transmitted by a cable with greater pressures.

Periodicity—After much fluctuation the practice of to-day seems to be steadying down to a frequency of fifty to sixty for alternating currents. The Pacific Coast lines in California have adopted comparatively high frequencies—the Niagara company standing almost alone with its low periodicity. It is interesting to note that of the seventy-three power transmission installations referred to above, thirty of them operate at a frequency of sixty cycles or over, and twenty-eight at between fifty and sixty cycles.

Lightning—It is necessary in some countries to make very elaborate protection against lightning discharges. Atmospheric difference of potential can best be provided against by stapling a barbed wire to the poles and frequently earthing. The increase in capacity in the cables due to this wire is said to be not appreciable. Disruptive discharges are dealt with by lightning arresters, of which there are many designs.

Earthing—There is considerable difference of opinion as to the advantages and disadvantages of earthing the neutral point in a polyphase system of distribution. It appears to us that the advantages of earthing are considerable. In an unearthed system the static capacity between wire and earth with high pressures becomes a source of danger, and this static capacity may be eighty-three per cent higher than it can possibly be if the neutral of a three-phase system be earthed. When the neutral is earthed faults are immediately detected, and must be removed. On the whole the voltage available in case of accidental contact tends to be reduced by earthing the neutral point.

CAPACITY.

The charging current required for long lines even when fixed overhead is very large. A 100-mile line working at about 50,000 volts and with a periodicity of fifty requires a charging current exceeding 2,000 kilo-volt-amperes. This is equivalent to the full current load of a 2,600 electrical horse-power plant. Unless the capacity is neutralized by reactive coils it becomes uncommercial to transmit powers at this pressure of less than 3,000 kilowatts. The use of high-potential reactive coils, which are made preferably without an iron core, and placed as a shunt across the mains at suitable positions on the line, is a rather expensive expedient and also involves the introduction of many points of possible breakdown of insulation which are better avoided. Further, these coils should be disconnected as the load comes on. The charging current on underground cables is of course much greater than on overhead. Large synchronous motors on the line with their field strength suitably adjusted can be arranged to neutralize the capacity of the cable, but their field strength must be varied with the load on the line. An ideal arrangement would be to balance the constant self-induction by constant capacity and the variable self-induction by variable leading load.

Though this capacity current, being expended reversibly, does not represent proportionate loss in watts, it does involve considerable loss at light loads and also results in bad regulation, the leading current causing an alteration in the ratios of the transformers and in the field excitation of the generators. It should be noted that the current required to charge cables is greater when the current curve departs from sine form, and it has been stated that the charging current may be increased from 200 to 300 per cent when the waves are jagged.

Loss in Line—The loss in the conductors must of course be worked out for the greatest economy in each case, with due regard to the spirit of Kelvin's law. In long lines the loss may be as much as fifty per cent. One hundred amperes is about the limit which can be transmitted on one line from 100 to 200 miles long, owing to inductive drop which, with a 200-mile line at sixty cycles and 50,000 volts, may amount to no less than fifty per cent. The necessity for high pressures to reduce the current upon which the in-

[1] Abstract of paper read at a recent meeting of the Manchester Section of the British Institution of Electrical Engineers.

ductive loss per mile depends, becomes, therefore, very evident when the length of the line is great.

REGULATION.

In 1896 one of the authors of this paper in conjunction with Mr. A. Still submitted a communication to the Northern Society of Electrical Engineers, a section of which dealt with feeder regulation with static boosters. Since that date certain improvements have been made in the variable induction type of regulating transformer, whereby its inductance and magnetizing current have been substantially reduced. A further improvement consists in fixing shading coils on the movable core in the positions shown, and marked *s c* in the diagram. These shading coils neutralize the inductance of the secondary circuit when the movable core is in intermediate positions.

Lastly, the slots in the ring which contain the secondary coils are so placed that the area of gap between movable core and ring is as large and as equal as possible in all positions, thereby keeping the magnetizing current as low and as constant as possible.

The result of these improvements has been to bring the apparatus up to a standard which leaves very little room for further improvement.

ABNORMAL PRESSURE RISE IN TRANSMISSION CIRCUITS.

A great deal has been written upon the subject of rises of pressure which take place under certain conditions in long circuits having considerable self-induction and capacity. Mathematicians have figured on the subject at length, and experimentalists have reproduced many of the phenomena accompanying line disturbances. At the same time the subject is enveloped in a certain amount of mystery, and can not be considered as fully understood.

It is important that engineers should understand as far as possible the physics of these phenomena. In the first place, the rises of pressure are beyond question great in destructive effect. A rise of pressure of one-quarter to one-half a million volts has been observed on a half-mile high-tension cable with considerable self-induction when the circuit was broken, the normal pressure being only 10,000 volts.

Passing over the opening of circuits of large self-induction *per se,* such as field coils, first consider the case of opening a circuit having self-induction and also capacity to an appreciable extent. In this case the capacity takes the place of the arc formed at the switch of fuse break as the equivalent of a relief valve tending to reduce the rise of pressure, and at first sight it might be thought that the presence of capacity was just what was wanted. Indeed, it has been pointed out again and again that underground cables having necessarily more capacity than overhead, are freed thereby from such severe rises of pressure. But the arc, when steady and maintained, is a far more efficient relief to the line than capacity. In the arc the electromagnetic energy stored in the cable is discharged through resistance, and thereby doing work, is dissipated. But if capacity exists, the arc is abruptly extinguished owing to the rise of pressure sufficient to maintain it being checked by the flow of current into the condenser. The full amount of electromagnetic energy stored in the cable will therefore be converted into electrostatic energy in the condenser. At the moment the cable was opened the condenser was charged by the normal pressure of the circuit, so that the charge it receives from the electromagnetic energy of the line will, according to its measure, increase its pressure. It is easy to calculate what this rise of pressure will be if the data be given. But that is not all, the condenser differs from the arc in that it does not dissipate the energy put into it, but instantly returns it to the circuit to be reconverted into electromagnetic energy. The process is then reversed again, and an oscillation set up between the electrostatic and electromagnetic state at a rate depending upon the natural period of oscillation of the circuit which will be slower the longer the circuit may be. The frequency will in all cases be very much higher than the normal frequency of the supply to the circuit. It has been shown that under certain conditions a pressure rise in volts may occur of two hundred times the interrupted current in amperes, and these conditions are such as may occur on commercial transmission lines.

It thus appears that to draw out a long arc at the switch contacts is the safest way of opening a circuit of high inductance, and in our opinion with continuous currents this is the best practice. With alternating currents, however, a new disturbing factor is introduced by the open air arc. It is well known that an arc between carbons will emit a musical note if it be shunted by a condenser and arranged in series with a very small amount of self-induction, such as will be obtained from the conducting leads or a coil of wire. This musical note is due to the arc being intermittent, and the rapidity of these interruptions may, at any rate in the case of an alternating-current arc, be very great—3,000 or 4,000 per second. Here then are all the conditions which are well known as the cause of pressure rise. In an induction coil or transformer the induced pressure increases proportionately to the frequency of intermittence of current or of alternation when the induction in the core is constant. Metal arcs are much worse than carbon, the conducting vapor of the latter tending to prevent the intermittent extinction of the arc. Soft carbon break would be the safest, and there is an open field for switch designers to construct an air break switch, the arc of which shall be maintained at gradual increasing resistance, and the first break in which must be the last. A low-resistance intermittent arc is the worst of all for producing the above effects.

On all high-potential alternating-current circuits the oil break switch is being generally adopted at the present time. But an oil break switch, though it prevents the formation of the dangerous intermittent arc, appears to be an unscientific method of opening any circuit with appreciable self-induction. The self-induction of the circuit being the same, it seems to us to be equally bad to open an alternating-current as to open a continuous-current circuit abruptly, whether under oil or by magnetic blowout. It is true that there are many chances against opening the alternating-current at its mean value, but at the same time, are there not some chances that it will open at the wave crest which is, with a sine curve, forty-one per cent higher than the mean? We are unable to see any physical difference between the suddenly opened alternating-current and the continuous-current circuit in respect to rise of pressure due to the accumulated electromagnetic energy with which the circuit is linked if the current is the same in each case. At the same time, if it can be shown that the oil break switch always opens the circuit at a point in the current wave much below the mean, our objection would be withdrawn. We do not in any case contend that the oil break switch is not the best form for engineers to adopt at the present time for very high-pressure circuits which must be opened under load, though water break is safer in cases where space can be afforded.

While the opening of a circuit under load is the worst condition causing rises of pressure, rises will also occur when an unloaded line is opened or closed. According to many authorities on this subject the rise can not exceed double the

normal pressure under these conditions. As a matter of fact, however, a higher pressure than double the normal has been recorded when closing the switch of an unloaded line of forty-four miles in length. This increased rise is probably due to some coincidence between the crests of the impressed waves of electromotive force and the crests of the waves of electromotive force of high frequency, which accompany the natural oscillations in the cable.

Reviewing the whole question one is forced to the conclusion that circuits having appreciable capacity and self-induction should not be switched on or off, whether loaded or unloaded, suddenly. All surging currents should be avoided, and fuses should be used only when the natural reactance of the circuit is too small to prevent a dangerous rise of current.

CABLE CHARGING APPARATUS.

The earliest cable charging apparatus is that installed at Deptford, Willesden, and in other places. It consists essentially in closing the circuit through high inductance, which inductance is gradually removed by manipulating a liquid resistance in series with a secondary winding on the inductance coil. An ordinary transformer can be used. It is important with this apparatus to short-circuit the primary winding as soon as the full electromotive force is indicated by the circuit voltmeter. If this is not done a rise of pressure fifty per cent above the normal may occur on the circuit.

Another method of charging is to run up a separate motor alternator on the circuit, and then to synchronize and parallel. The chief objection to this system is the time it takes to perform the operation, and the apparatus must also be somewhat complicated and costly. This system is in use in Manchester and elsewhere.

A third method is one which one of the authors worked out some years ago. It consists in using a regulating transformer. The secondary is wound to give the full electromotive force of the circuit when the movable core is in the position of maximum effect, and the primary is excited from the main bus-bars.

The last arrangement for cable charging is a variable water resistance method put in series with the feeder. This system has been recently worked out by Messrs. Ferranti.

DUPLICATION OF TRANSMISSION LINES.

Without question every high-potential line should be duplicated. The Board of Trade in general insists upon this being done. These duplicate lines should be run in separate ducts if laid underground, and on separate poles if overhead. It is not safe to work on a high-potential line while any of the wires on the cross-arms is alive.

Some engineers have held the view that to ensure continuity of supply one of the lines should be kept as a spare—that is to say, the duplicate line should not be coupled in parallel.

When it is remembered that the line losses are proportional to the square of the current, it will be clear that the losses in transmission will be four times as great if the spare main is kept idle. It will be evident, therefore, that the difficulties arising through coupling the mains in parallel must be very serious to induce engineers to increase their line losses fourfold rather than face these difficulties. A system can not be considered efficiently duplicated unless arrangements are made for reliably disconnecting the short-circuited feeder from the system, leaving the supply maintained through the healthy feeder. Many attempts have been made to do this by inserting fuses at each end of both of the feeders. These fuses should evidently all be of the same capacity, as it can not be foreseen that any one of these will be required to carry more or less than the other.

A perfect duplicate transmission line should, we think, fulfil the following specification:—

(*a*) It should be possible without increasing the risk of an interruption to the supply to keep both lines in continual service, thereby reducing the line losses by seventy-five per cent.

(*b*) A fault on either line should have no effect on the remaining line, other than causing it to carry the whole load previously borne by the two.

(*c*) The supply to the distributing centre should not be even momentarily interrupted as the shortest interruption is sufficient to cause synchronous motors to fall out of step.

A system devised some years ago by one of the authors, which is in use in this country and in the United States, is to place return current, or discriminating cut-outs, at the distributing end of the transmission lines in place of fuses.

This system meets the requirements of the case for high-resistance faults, but difficulties occur with low-resistance alternating-current faults.

Another defect which the above arrangement shares with a system protected by fuses alone is that immediately the fuse on the power station side of the fault has blown, the whole of the current to the short will be thrown upon the healthy main, and if the cut-out or fuse at the distributing end of the faulty main operates, when it will be required to break this heavy short-circuit current with consequent line disturbance.

A simple method for the protection of duplicate mains is to connect the feeders together at the distributing end by choking coil, wound entirely in one direction. The supply to the load is taken off from the centre of this coil.

Under normal conditions, the current divides equally between the two feeders and the two halves of the choking coil, but the current from one feeder flows round the iron in one direction, and from the other feeder in the opposite direction, and as a consequence the winding is perfectly non-inductive, and the only resistance to the flow of current is that due to the ohmic resistance of the circuit.

Should a fault now occur the current will tend to feed back toward the short through the choking coil at the distributing end of the lines. This current will, however, be entirely in one direction, and the choking coil will, in consequence, become a highly inductive resistance, and will prevent a heavy current flowing to the short. The supply will not be even momentarily interrupted, but it will be maintained at half pressure only, so long as the faulty main is connected to one side of the choking coil.

The system described above, which has been recently shown in practical operation to a number of engineers at Hastings, appears to us to fulfil the three requirements specified above at a reasonable cost.

Death of E. T. Gilliland.

Mr. Ezra Torrance Gilliland died of heart failure at his residence in Pelham Manor, N. Y., 4 A. M. Wednesday, May 13. Mr. Gilliland was a pioneer telegraph operator and telephone inventor. He became an expert telegraph operator about the time of the commencement of the Civil War. When the telephone was invented, he became interested, both as a manufacturer and inventor. His patents related to central office apparatus, magneto call bells, etc., and his work was considered of first importance in advancing the development of the telephone. He was associated with Edison a number of years. Of late he has not been so active in electrical work, and has resided at Pelham Manor. He leaves a very wide circle of electrical friends. A widow and several relatives survive him, but no children.

During the week beginning June 1, Professor J. J. Thomson, F. R. S., Cavendish professor of experimental physics in the University of Cambridge, will give a course of lectures in the physical laboratory of the Johns Hopkins University on "A Theory of the Arc and Spark Discharges."

NATIONAL ELECTRIC LIGHT ASSOCIATION.

TRANSPORTATION ARRANGEMENTS AND LIST OF PAPERS.

As the time for the holding of the twenty-sixth convention of the National Electric Light Association convention draws near, the evidence which the officials in charge of the arrangements are witnessing gives promise that this convention, which will be held in Chicago, Ill., May 26, 27 and 28, will exceed in number of attendants and enthusiasm any convention held by this association heretofore. The headquarters of the association will be at the Auditorium Hotel. Arrangements have been made with Mr. M. C. Roach, general eastern passenger agent, New York Central Railroad, for a special train of Pullman cars for the use of eastern members and delegates attending the convention.

The train is scheduled to run by the New York Central & Hudson River Railroad and the Michigan Central Railroad, leaving New York on Sunday, May 24, at 12.50 P. M., Albany at 3.50, Buffalo (central time) at 10.50 P. M., Boston, *via* Boston & Albany, at 10.45 A. M., arriving at Chicago 2.50 P. M. Monday. The fare from New York is $22; return, $6.70.

The subjects to be considered at this convention are of an exceptionally broad and instructive nature, taking in features the understanding of which is essential to central station management. The reports, which have been compiled by the special committees designated, are said to be particularly complete. The following papers have been announced:

"Fuel Losses in Furnaces and Boilers, and How to Lessen Them," by Mr. A. Bement.

"Salt as a By-Product," by Mr. Alex Dow.

"Advantages Derived from the Use of One System of Generation and Transmission in One Locality," by Mr. C. L. Edgar.

"Tactful Relations with Customers," by Mr. J. W. Ferguson.

"Relative Advantages of Electrical and Mechanical Methods at Variable Speeds for General Power Service," by Mr. Wm. Cooper.

"First Aid Appliances," by Mr. J. D. McGowan.

"Standard Rates for Transformers," by Mr. John S. Peck.

"Steam Turbines," by Professor Wm. Lispenard Robb.

"The Application of Four-Ampere Series Arc Lamps for Street Lighting," by Mr. J. Henry Hallberg.

"Some Fundamentals of Photometry," by Professor H. E. Clifford.

"Exhibition and Description of the Matthews Integrating Photometer," by Professor Charles P. Matthews.

"Attitude of Employer Toward Benevolent Insurance and Educational Associations Among Employés," by Mr. Arthur Williams.

"District Heating," by Mr. John W. Glidden.

"The Young Engineer and the Electric Lighting Plant," by Mr. Charles F. Scott.

Committee reports:

"Report of Editor on Progress," by Mr. T. C. Martin.

"Decorative and Sign Lighting," by Mr. Arthur Williams.

"Unaccounted-for Current," by Mr. L. G. Van Ness.

"Theft of Current," by Mr. R. L. Elliott.

"Office Methods and Accounting," by Mr. W. M. Anthony.

"Photometric Committee," by Mr. H. L. Doherty.

"Committee on Analysis of Flue Gases," by Mr. H. L. Doherty.

Professor Elihu Thomson will also present a paper, and Mr. H. T. Hartman, editor of the question box, has a complete file of subjects for discussion.

Mr. James Wolff has been appointed by President Louis A. Ferguson chairman of the local reception and entertainment committee. This committee has arranged to have a general reception in the Auditorium parlors on Monday evening, May 25, from 8.30 to 10.30. Arrangements are also being made for a tally-ho party on Tuesday morning for the ladies attending the convention, to drive to the Washington Club, where they will have luncheon. After luncheon they will drive through the South Park, returning to the hotel in the afternoon. A matinee party at one of the theatres is contemplated for the ladies on Wednesday afternoon.

Progress in the Plans for an Engineering Building.

On May 7 the board of directors of the American Institute of Electrical Engineers held a meeting to consider the offer of Mr. Andrew Carnegie to donate one million dollars for the erection of an engineering building which would be occupied by the various engineering organizations. Mr. Calvin W. Rice, chairman of the building committee, presenting a report covering the endeavors of the Institute for a number of years to secure a building. A committee was appointed to represent the board of directors of the Institute at such conferences as may be had with reference to the subject. This consists of the president, Charles F. Scott; Mr. Calvin W. Rice, chairman of the building committee, and Mr. T. C. Martin.

On the evening of May 7 an informal meeting was held at the house of the American Society of Civil Engineers, sixty-five gentlemen were present, including President A. Noble, of the Civil Engineers; Dr. A. R. Ledoux, of the Mining Engineers; J. M. Dodge, of the Mechanical Engineers; C. F. Scott, of the Electrical Engineers, and J. C. Kafer, of the Engineers' Club, and the subject was discussed freely.

President Dodge reported that at the meeting of the Council of the American Society of Mechanical Engineers, the formal resolution proposed in the letter of W. A. Redding, Esq., had been adopted, and a committee appointed, comprising Professor F. R. Hutton, C. Wallace Hunt, and himself, to act as a conference committee with the other societies.

President C. F. Scott, of the American Institute of Electrical Engineers, stated that the board of directors had endorsed the resolution provided by Mr. Redding and had appointed a conference committee. He stated further that it was expected by the board that final action would be taken on May 19, as there was a board meeting of an annual meeting of the Institute on that day. President Raymond, of the American Institute of Mining Engineers, stated that their institute had had a board meeting the following day, but he thought it was a question, not whether they would come in, but the best way of doing so.

Past President George S. Morison, of the American Society of Civil Engineers, stated that, as that society already had a building, conditions were different with them, but he was of the opinion that the relations which they should sustain with the general engineering interests were such that the society should join with the others.

Representatives of the Engineers' Club expressed hearty accord to the general scheme.

Resolutions were adopted unanimously expressing appreciation and thanks to Mr. Carnegie for the generous offer he had made and a despatch was sent to him by cable to that effect.

Mr. Kafer stated during the evening that Mr. Carnegie had also undertaken to finance the land for the societies, and that interest at four per cent on the land investment would not be asked by Mr. Carnegie until the building itself was finished. Mr. Carnegie's agent, Mr. R. A. Franks, had already paid out for them $50,000 in options on the properties on Thirty-ninth street, which now represented a buying price of $517,000. The following conference committee has since been appointed by the American Institute of Mining Engineers: Dr. A. R. Ledoux, Mr. Charles Kirchoff and Theodore Dwight.

The following conference delegates have been appointed by the Engineers' Club: Mr. John C. Kafer, Mr. W. H. Fletcher, and Mr. W. A. Redding.

The Dedication of the Louisiana Purchase Exposition.

On April 30 the initial ceremonies of the dedication of the Louisiana Purchase Exposition were held at St. Louis, Mo. The following two days, May 1 and 2, were given up to extraordinary functions, celebrating the dedication of what promises to be the most elaborate and successful world's fair ever held. The three days were designated, respectively, as Centennial Day, International Day, and State Day. There were present a host of representatives of foreign countries, and dignitaries of every great nation, together with the chief officials of every state in the Union. The military display was probably one of the finest ever made in time of peace, there being 150,000 men in line, President Roosevelt and his escort heading the line of march. Notwithstanding the inclement weather, the greatest enthusiasm was manifested on all sides, and the authorities in charge of the Louisiana Purchase Exposition conducted the ceremonies in such a way as to elicit the universal commendation of all present.

Upon the conclusion of the invocation by Cardinal Gibbons, the Hon. David R. Francis, president of the exposition, introduced Mr. Thomas H. Carter, of Montana, president of the National Commission, who delivered the opening address. After the rendering of an anthem by a grand chorus of 1,000 voices, President Francis delivered an address.

Doubts have been suggested as to the possibility of having the exposition ready on time for the formal opening on May 1, 1904. In this regard, however, the authoritative utterance of President Francis at the banquet given in the Administration Building on the evening of May 1 to the visiting newspaper correspondents, was essentially that nothing short of an act of Providence would prevent the opening of the exposition at the time and on the day arranged. During this banquet eloquent speeches were made by President Roosevelt, ex-President Cleveland, Senator Hanna and Mr. John B. Mitchell, the labor leader. Others spoke, the main trend of the speeches being eulogistic of the benefits derived by reason of the Louisiana Purchase.

For some unexplained reason the rumor has gone forth that the electrical department of the World's Fair will not be able to complete its arrangements in time for the formal opening. The assurance of the chief of the Department of Electricity, Professor W. E. Goldsborough, is in direct opposition to this suggestion, and, as a matter of fact, there is no building on the exposition ground more forward than the one to be devoted to electricity. Chief Goldsborough has already completed arrangements for working exhibits from the foremost electrical firms of the world, which will assure a display in every way commensurate with the dignity of electrical engineering.

There seems to have been extant considerable unfavorable comment on the treatment accorded to the visiting representatives, and the scant attention shown to the prominent persons in attendance at the ceremonies. If there is any truth whatever in these statements, it is in direct contrast to the experience of the visiting newspaper men.

Wireless Communication with Iceland.

Plans are under way to establish a wireless telegraph service between Iceland and the north of Scotland. The cooperation of the British Government has been asked, but the Postmaster-General did not see his way clear to advise the government to give financial aid to a foreign company. It is stated that a general agreement has been arrived at between the Marconi Wireless Telegraph Company and a group of Danish financiers of Copenhagen, with a view of carrying out the scheme; and there is some possibility that if other governments aid, the British Post Office will not be unwilling to cooperate.

Index of the Technical Press.

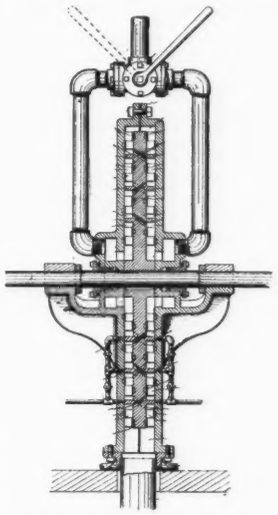
The first number of the *Index of the Technical Press,* dated April, 1903, has come to hand. This index is published monthly in the three principal commercial languages—English, German and French. The English, French and German journals are indexed in these languages, respectively. Those journals published in languages of Latin origin—Italian, Spanish, etc.—as well as the Russian papers, are indexed in French. The Scandinavian and Dutch journals are indexed in German. While this index aims to cover the art of the engineer first, other indices will appear, dealing with chemical technology, the textile industries and other branches. A decimal system of classification has been adopted, and is used throughout, each item being properly numbered. Articles are indexed under a serial number and a classification number. The title is given, a brief indication of the scope of the article, where it appeared, and the number of words. These references are printed on one side of the paper only, so that they may be clipped for card filing. The publishers are prepared to furnish the text of the articles indexed. This index is published by the Association de la Presse Technique, rue de la Chancellerie, 20, Brussels, and the subscription price is $1 per year.

Electrical Patents.

Mr. Hans Biehn, a resident of Budapest, Austria-Hungary, has patented in this country a new method of producing electric insulating bodies, and this patent has been assigned to the Pyrisolith Isolating Material Manufacturing Company, Limited, of Budapest. The present invention relates to a method for producing electric insulating bodies of brittle pulverized insulating material and a fusible bituminous substance, which bodies are adapted to be used for various purposes and are characterized by their superior insulating quality and capability of withstanding external influences. The essential features of the method are as follows: The brittle material, which in itself is a good insulating agent, has to offer proper resistance to external influences, for which purpose lime, gypsum, magnesite, porcelain-clay, quartz, mica, glass, and the like are, for instance, used. The natural or artificial bituminous substance should be solid at ordinary temperature and commence to melt only at thirty-seven to fifty degrees centigrade, those products known as bitumen épuré or goudron being particularly suitable. One of the brittle insulating materials referred to above or a mixture of several such materials is finely pulverized and heated to a temperature of 70 to 100 degrees centigrade. For the purpose of maintaining the temperature the heating takes place in double-walled receptacles, preferably revoluble closed cylinders, which are heated by means of hot water, steam, or air passed between the double walls in a manner adapted to be easily regulated. On the powder being brought to the desired temperature the fusible bituminous substance or a mixture of such substance is added, preferably in proportions of eighty-nine to ninety-three parts of powder and eleven to seven parts of bitumen, all taken by weight, the mass at the same time being stirred and the temperature maintained. When the mass has been thoroughly mixed, a dry and loose powder is formed, even at the aforesaid temperature, said powder containing very few lumps, which, however, can be easily ground to powder. The powder-like material thus obtained can be directly used in the manufacture of insulating bodies; but it is preferable to leave it to cool and then after the lumps contained therein have been ground to heat it in the closed receptacles described above, according to its conditions, to a temperature of 140 to 180 degrees

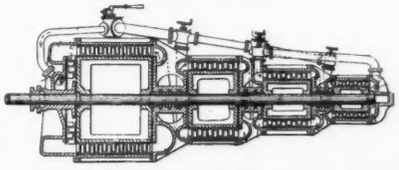
centigrade before being moulded, at the same time care being taken to prevent as far as possible the escape of the gases produced in the heating. The mass is then brought into suitable moulds, according to the insulating bodies to be produced, and compressed under high pressure to about half their volume. It is preferable that the objects removed from the moulds should be allowed to cool slowly. For producing the mass natural bituminous substances may also be used, which contain the necessary ingredients and in which the proportions can be suitably changed, if necessary, by a corresponding addition of lime or the like of bitumen. The bituminous substances are finely ground and further treated according to the method described above—that is to say, heated to a tempera- of 140 to 180 degrees centigrade and compressed in moulds. In order to increase the solidity, the mass can be vulcanized in the known manner, after the mixing of the ingredients has taken place, by means of an addition of sulphur up to one per cent. According to the method described above any insulating bodies—for instance, cup insulators, insulating tubes, supports for incandescent-lamp holders, cable boxes, or the like—can be made which were hitherto made of porcelain, micanite, ambroin, enameled iron, or the like. Larger objects may be suitably painted.

Three United States patents issued the same day to residents of three different countries afford ample evidence of the activity that is being shown by inventors in the rotary engine or steam turbine art. The first of these patents was granted to Mr. Alfred W. Case, residing in Highland Park, Ct., and the object of his invention is to provide a compact and efficient steam turbine having plates so located and arranged that the pressure is equal on opposite faces of the disc, forming the rotary piston. In the invention a circular casing is employed provided with external outwardly extending arms which support a shaft that extends through the casing. A perforated disc is mounted on the shaft within the casing and is spaced from the inner faces of the same. Annular flanges divide the spaces between the sides of the disc and the sides of the case into annular chambers, while annularly arranged curved blades extend from the sides of the disc into each annular chamber. Similarly arranged curved blades also extend from the sides of the case into each annular chamber in opposition to the disc plates, while the passages or perforations through the disc are so arranged that they extend from each inner annular chamber to the next outer one on the opposite side. When steam enters the case through a suitable port, it passes first through the curved passages between the blades attached to the inside of that side of the



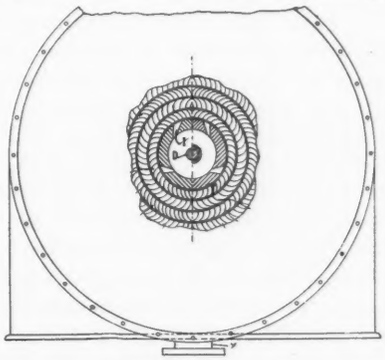
DUPLEX STEAM TURBINE.

case, and is projected in jets against the concave faces of the opposing blades attached to the disc. After passing between these plates, the steam escapes through the perforations to the opposite sides of the



COMPOUND TURBINE.

discs and into the next outer chamber, thence it is projected again inwardly against the adjacent faces of the blades attached to that side of the disc. By means of this construction and arrange-



NEW FORM OF TURBINE.

ment, the steam pressure is exerted upon opposite sides of the disc proper with the same force, so that the pressure is balanced.

The second patent was granted to Mr. Richard Schultz, residing in Berlin, Germany. This invention relates to compound turbines generally, embracing both axial and radial structures, either tandem or cross-compound, and the aim of the inventor is to obtain an arrangement which will permit the ready control of any turbine individually, or combining any one with any other in a suitable manner so as to economize steam consumption. It is an established fact that turbines develop the greatest efficiency when running with the maximum load or power, and, on the contrary, develop the least efficiency on a small load. In order to arrive at an economical working, it is simply necessary to place upon the shaft one or more turbines capable of being run individually and compounded, whereby, when small power is required, steam can be admitted to one only, and this one can thereby be run to develop its maximum power without running the others. In the arrangement a plurality of turbines are connected to a common shaft. Steam pipes interconnect the turbines and other pipes are employed to conduct the full volume and pressure of the steam to the turbines. Suitable valves are arranged in these pipes so as to combine in tandem from higher to lower pressure turbines in any order, or a plurality of higher pressure turbines in parallel can be compounded with one or more lower pressure turbines in series. As a result, different speeds can be obtained without throttling the steam.

The third patent was obtained by Mr. John Mercer, residing in Liscarde, England. This invention is intended particularly for driving dynamos, though it can be employed for any ordinary purpose. The improvements relate to that class known as "radial flow" turbines, in which the actuating fluid travels from the centre radially outward toward the circumference. During its passage it expands and attains great velocity impinging on the rings of vanes, causing the latter to rotate, and being finally exhausted from the outside of the casing, which encloses the vane discs, to the atmosphere, to a condenser or to a low-pressure turbine. The usual stationary cylindrical casing is employed, through which passes an axial shaft carrying a central rotary disc. Other rotary discs are mounted on opposite sides of the centre disc and are connected at their peripheries. Rings of vanes project from the opposing faces of the centre disc and the peripherally connected discs. Other rings of vanes project from the opposing faces of the rotary discs and the peripherally connected discs, and are arranged reversely to the adjacent vanes. Hollow axial journals or shafts project from the outer connected discs and the bores thereof communicate with a central chamber or chambers, formed within the rotary discs. Nozzles in the walls of these chambers guide the steam against the vanes of one set of discs so as to rotate the central disc in one direction, and other nozzles may be employed so that the movement of the centre disc can be reversed, when desired.

Reviews of Current Engineering and Scientific Literature.

The Speaking Oil Lamp.

The phenomenon of the speaking electric arc is well known, and it is interesting to note that other flames behave in the same way. In this article Herren A. Batschinski and V. Gabritschewski describe a simple experiment which demonstrates this action. A Bunsen or other convenient form of lamp has one terminal of the secondary of an induction coil attached to the metallic burner, the other terminal being introduced into the flame. The primary of this induction coil is connected in series with a battery, a microphone transmitter and regulating rheostat, the transmitter being placed at some distance from the flame. When the transmitter is spoken into, the flame reproduces the sound clearly and distinctly. The current passing through the primary coil is preferably strong. The effect is increased by placing a second lamp in series with the first, connecting the base of this to the second terminal of the induction coil and completing the circuit through a wire introduced into the two flames. The action is caused by the great change of potential at the terminal in the flames.—*Abstracted from Physikalische Zeitschrift (Leipzig), April* 15.

The Use of Independent Crane Conveyors for Coal Supply in Central Stations.

In this article Mr. E. Kilburn Scott discusses the use of coal and ash conveyors for central stations. Until recently, conveyors were not thought necessary in English stations, and many buildings have been erected which do not adapt themselves to the installation of a complete conveyor plant. The question of cost is also an important one for small stations. For such cases the author believes that there is a future for the small independent crane conveyor, such as has been used for carrying luggage about railway stations and other large industrial buildings. The crane conveyor is actuated by an operator who rides with it, and it runs on overhead steel girders or rails. Consequently, it may be taken in and out around curves of a comparatively small radius and into out of the way corners, which could not be served by ordinary continuous conveyors since the latter must always work in a straight line. A plant of this type has been in operation at the Brompton station for some time, with much success. This conveyor will lift a gross load of sixteen hundredweight at a speed of twenty-six feet per minute and will convey it at a speed of 700 feet per minute. It is equipped with one three-horsepower motor. One advantage of conveyors of this kind is that they may be used for handling other materials as well, and they are more economical than a continuous conveyor.—*Abstracted from Electrical Review (London), April* 24.

The London County Council Tramways.

The first line of the London County Council tramways to be equipped electrically is now practically ready. In 1899 the London County Council sent an engineer to this country to report on city traction systems. He recommended the adoption of the conduit system, and submitted plans for an experimental line. Two experimental sections of track were constructed, of different systems, and a comparison of the two in operation resulted in a design differing from both. This article gives the particulars of the conduit system which has been installed in the Tooting line, a road which, with its branches, makes about eight miles of track. This system differs somewhat from the American types, as the yokes do not support the wheel rails. The yoke is a U-shaped casting of I-section, to which the Z-bars of the slot rails are bolted. The slot rail is further held in position by tie bars bolted to a lug on the casting. The conductors are supported from the slot rails by insulators placed every fifteen feet. The insulator is held by an iron cap, surmounted by a flange which is bolted to the flange of the slot rail. The insulator is held in this cap by Portland cement, and within it is set the lug which carries the slot rail. The T-rails are in thirty-foot lengths, though forty-five-foot rails have been adopted for the new work. Anchor rails were used under each joint. At intervals of forty yards there are cleaning-pits connected to the conduits by twelve-inch pipes, with a slope of one in ten, in turn connected to the sewer through traps. The conductors are interrupted every half mile by a two-foot gap, the ends of the rails being slightly flared. At switches and crossings the break is considerably more. At the sections the insulators holding the conductor rails are duplicated to guard against injury from the shock of the incoming plow.—*Abstracted from the Electrician (London), April* 24.

Electricity as a Motive Power on Trunk Lines.

In an article published last fall Mr. Cornelius Vanderbilt discussed the applicability of electricity as a motive power on trunk lines, and attempted to show that financially it could not compete with the steam locomotive. In this article, Mr. C. L. de Muralt takes issue with Mr. Vanderbilt with a view to showing that it is possible to use electricity as a motive power on trunk lines and to reduce the expense of operation. The cost of a unit amount of coal is assumed that in both cases this will be the same. The author assumes that the railway company buys its power and therefore the cost of installation and operation of the power-house does not enter. An efficiency of sixty per cent at the axles is assumed for the electrical system, and the cost of motive power per train-mile for the average passenger train is given as six and one-half cents, and for the average freight train, thirteen and one-half cents. This is thought to be a little better than the performance of the steam locomotive. The saving brought about by the use of electricity in reducing the unnecessary dead weight of the locomotive and the saving of fuel when the locomotive is not at work, and for switching engines is figured out at ten per cent for the cost of motive power. All expense for water for the locomotive is saved, and the cost of oil waste and packing would be reduced fifty per cent, and by combining the electric locomotive with the passenger car, or caboose, the conductor or baggage-man takes the place of the fireman. The reduction in wages at the roundhouse would be reduced to twenty-five per cent. The cost of repairs of the cars is assumed to be the same in both systems. The repairs of the locomotive would be reduced by the elimination of the boiler and the tender, making a reduction of fifty per cent. In the absence of accurate data it is assumed that the saving of the track, due to the elimina-

tion of pounding, will be balanced by the additional expense of maintaining the third rail. This analysis is applied to two roads, the Pennsylvania and the New York Central for an alternating-current, high-potential system, the line equipment is estimated at $7,000 per mile. It is estimated that the saving in operating expenses will be about twenty per cent of the cost of installation. Although the two roads selected have very dense traffic, it is thought that there are many other roads which could be converted to electric operation with good results.—*Abstracted from the North American Review, May.*

Electrification of the Mersey Railway.

The Mersey Railway passes through a tunnel under the Mersey River, connecting Liverpool and Birkenhead. The suggestion for this tunnel was made the first part of the last century, but work was not started until 1879, when an experimental tunnel was driven to determine the character of the ground. This proving satisfactory, work on the main tunnel was begun and the line opened for use in 1886. Since this time several extensions have been made to the main tunnel line so as to connect with several long-distance lines of the country. The main line is 6,336 yards in length and one branch is 2,257 yards long. The main tunnel is twenty-six feet in extreme width and nineteen feet high, lined throughout with brick. The experimental tunnel is now used for ventilation. The road has never been a financial success and it was decided to electrify it, thus avoiding a smoke nuisance and in the hope of bringing about better business conditions. This has been done and the line will shortly be in operation. Two conductor rails are used, the negative being placed between the track rails and the positive on the outside and similar to the usual third-rail in construction. Each car carries three sets of collecting shoes, two on the outside, and one in the centre. The power-house contains nine Stirling boilers fitted with mechanical stokers and Clay-Cross economizers. In the engine room are three large sets of vertical cross-compound Westinghouse engines, driving directly 1,250-kilowatt double-current Westinghouse generators. There are also two smaller generating sets consisting of Westinghouse compound engines direct-connected to 200-kilowatt direct-current generators. The voltage in use is 650 direct current, and as yet no arrangement has been made for the use of alternating current. The station has also a battery installed in a separate building and containing 320 chloride cells. There are ten feeders passing from the power-house to various points on the line. These are all lead covered and paper insulated. The trains are formed of two motor cars with two or three trailers placed between them. The motor car trucks were built by the Baldwin Locomotive Works for standard gauge. Each truck is equipped with two Westinghouse 100-horse-power railway motors. The Westinghouse electropneumatic operating system is used, and there are also automatic couplings worked from the motorman's cab and a compressed air track sander. The motorman's cab is lined throughout with asbestos. These trains have been thoroughly tested on an experimental track. The tunnel has been cleaned and is lighted with incandescent lamps, and it is thought that the running time will be reduced by these trains from fifteen to eleven minutes. A three-minute service will be given from 5 A. M. until after midnight.—*Abstracted from Engineering (London), April 24.*

Huddersfield Corporation Tramways.

This article gives an excellent description of the addition to the Huddersfield corporation's railway power-house. The Huddersfield corporation was the first in England to undertake a tramway system. On this steam traction was used in 1883. The tracks are laid to standard railway gauge, allowing the hauling of merchandise. In 1898 it was decided to adopt electricity as a motive power, and the work of completing and extending the system has been going on since then. A new engine has just been added to the power-house which has shown an excellent performance. This is a cross-compound vertical engine, fitted with a reheating receiver below the high and low-pressure cylinders. The design has been worked out carefully to allow for inspection of the cylinder by removing a valve. The capacity of this machine is 1,000 indicated horse-power, and the performance shows a consumption of thirteen pounds of steam per indicated horse-power-hour, at 160 pounds steam pressure. This engine makes the total power available at the station 2,650 indicated horse-power. It drives a ten-pole, 650-kilowatt railway generator. All the steam piping has been carried out in duplicate. There are two economizers and a superheater which under actual test raised the temperature of the steam to 160 degrees Fahrenheit. The rail return feeders are each connected through a booster which compensates for the total drop in the feeder, making it necessary for the compounding of the generator to take care of the feeder drop only. The feeders are laid underground in earthenware ducts. Each car is fitted with two thirty-horse-power motors, and the brake equipment consists of the usual wheel brake and track brake operating on the rail, and a powerful rheostatic brake, these precautions being deemed necessary on account of the grades of the road. Particulars of the track construction are given. The rails are in sixty-foot lengths, and extra heavy fish plates are used. On hilly sections an anchor plate has been provided to prevent creeping of the rails. There are at present thirty-six miles of track equipped, over which sixty-one cars are operated daily.—*Abstracted from the Tramway and Railway World (London), April 9.*

The Electric Railway of Fayet-Saint Gervais in the Chamonix Valley, France.

In this section of the series of articles describing this French railway system are given some of the details of the electrical car equipment which are of interest. There are sixteen combined motor and baggage cars, twelve combined motor and passenger cars of the second class, and sixteen of the mixed first and second class. There are also ten freight cars equipped with motors, and a number of trailers for passenger and freight service. The motor cars can be operated singly or in trains, and controlled from the leading car. The trucks are equipped with two sixty-five-horse-power motors, supported on the axles and springs. The motors are designed for 550 volts, with ample allowance for temperature rise. As the gauge of the track was but one metre, it was impossible to place the motors between the truck-wheels in the usual way. They are therefore arranged with their axles perpendicular to the car axles, and drive the latter through bevel gears and a flexible coupling. The motors are of the four-pole consequent pole type. The frame of the motor is cast in two parts, the lower part carrying the axle bearing and the armature bearings. Brackets attached to the sides of the motor support the brakes, thus giving a flexible connection between the brakes and the truck, which avoids much of the disagreeable effect caused by attaching the brakes rigidly to the car body.—*Translated and abstracted from l'Electricien (Paris), April 25.*

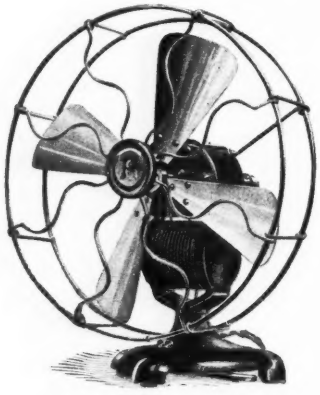
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Battery Fan.

There are many locations in which a convenient supply of electric current is not available, making the luxury of a fan motor impossible. Many efforts have been made from time to time to produce a battery fan motor which would operate successfully, but in too many instances the resulting apparatus was such that it was relegated to the class of toys, and served no useful commercial purpose.

Messrs. J. Jones & Son, 64 Cortlandt street, New York city, are placing on the market a battery fan, the general features of which follow closely the line of motors made to run on lighting circuits, and



A NEW BATTERY FAN.

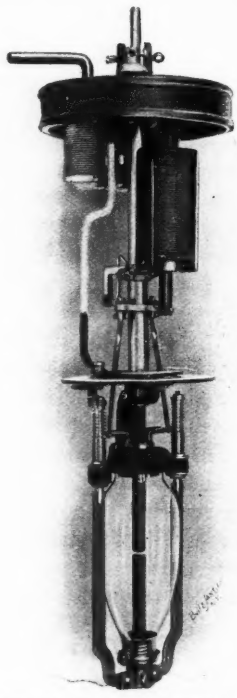
eliminating, wherever possible, the outlines or design of toy construction.

The body stands on the base containing the switch, and the fields are properly proportioned for work on low current, and in connection with the armature and commutator for high efficiency. The fan blades are well balanced, and the guard is of such construction that the fan may be subjected to rough handling without injury. The shaft is well balanced mechanically and lubricated by oil cups.

The battery furnished with this fan is of an improved design of the dry cell type, and is claimed by the manufacturers to run this fan, with ordinary use, for 250 hours.

New Type Enclosed Arc Lamp with All Parts Interchangeable.

The General Incandescent Arc Light Company, New York city, has made several improvements on its direct-current constant-potential lamps for 100 to 120 volts. The clutch is entirely insulated from the mechanism, and therefore no current can sneak over the working joints of the clutch links, feed lever and dashpot. This is an important point, and all of the G. I. lamps, for all circuits, now have insulated clutch supports. The adjustable regulating resistance is mounted on several porcelain units. The required number of resistance units is fastened by screws to a light circular casting which is attached to the top casting of the lamp. These resistance units are connected by



INTERCHANGEABLE ENCLOSED ARC LAMP.

screw clamps, and beginning and end leads are connected to the proper binding-posts under the top casting.

This form of resistance permits of the highest possible operating and maintenance of economy. Damage occurring in any part of the resistance wire does not disable the entire coil, but only a quarter or sixth part of it is affected, and such damaged part or unit can be replaced by removing three screws and inserting a new interchangeable unit. The whole resistance can be removed from the lamp by unscrewing the two supporting and two clamping screws.

The G. I. company has given considerable attention to the proportioning and designing of the adjustable resistance clamp, as for constant-potential lamps this is a question of essential importance. A well-designed clamp should always make a good elastic contact with the wire, preferably covering a considerable wire surface, preventing rusting, and also preserving a more perfect contact, and allowing for expansion and contraction of the supporting porcelains. The trouble which a poorly designed, adjustable contact will cause is perfectly obvious, owing to the possibility of the arc adjustment of the lamp changing, due to the increase in resistance of the contact between the clamp and the wire. Where lamps are hung out for some time without attention, this detriment becomes of such magnitude that the arc voltage is greatly decreased, with a possibility of the lamp burning out. The increased resistance and excessive heating at the point of contact between the clamp and resistance wire will, moreover, cause the wire to get brittle and weak, making it liable to break without warning. These troubles, the company claims, are entirely obviated with the new style broad-contact lamp adopted in the present design.

The solenoid or magnet coil construction differs from the type used on previous types, in that the coil is form-wound and is removable from the dashpot tube. This improvement separates the dashpot plunger, with its tube, from the magnet coil. In consequence of this change a new magnet coil can be placed on the lamp, without the dashpot and graphite plunger.

Direct-Current Integrating Meters.

Edward S. Halsey, Chicago, Ill., has placed on the market a direct-current integrating meter for which the claims of simplicity, substantial construction and permanent accuracy are made. The meter consists of a unipolar motor with frictionless mercury connection to the armature disc which drives the counting mechanism after the usual manner. It is composed, briefly, of the following principal parts—A powerful permanent magnet, Fig. 1; a solid amalgamated copper disc armature which rotates in a chamber filled with mercury; and a recording mechanism driven by a worm on the armature shaft. The top portion of the mercury chamber is moulded of insulating material, with a soft iron pole-piece and copper electrodes passing down through it to the mercury bath. This is shown in Fig. 2. The bottom portion of the chamber is a disc-like

iron casting, shown with the magnet in Fig. 1. A greater and definite part of the current passes through the copper disc, as its conductivity is nearly one hundred times greater. This current develops in the copper disc a torque and velocity in direct proportion to its amount as the disc is retarded by Foucault currents

FIG. 1.

generated in it by the strong concentrated field. The disc's movement is communicated directly to the integrating mechanism through the medium of the shaft.

As copper has a specific gravity less than that of mercury, it tends to float, and to compensate for excess buoyancy a small circular weight is fixed around the shaft with a soft rubber gasket ce-

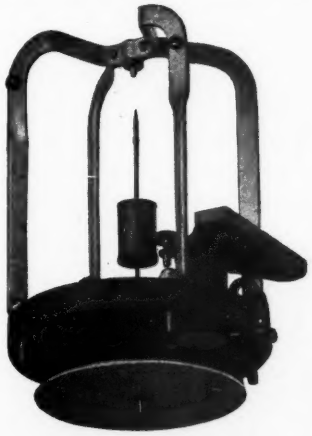


FIG. 2.

mented to its under side, the rubber fitting the shaft sufficiently tight to support the weight upon the shaft at any point.

Another object of the rubber gasket and weight is the sealing of the small central opening in the containing-receptacle mercury tight, which is accomplished by simply depressing the weight on the shaft into this socket on the top of the receptacle, and swinging the cross-bar from the left side across the top of the weight, so as to come beneath the thumb screw at the right side, by which screw the weight is held down in place and the gasket compressed, making the receptacle mercury tight, and locking the armature and shaft in place. This shaft, though quite slender, is of spring steel, so that it can not easily become permanently bent. Because of the mercury flotation there is no pressure on the bearings at the end of the shaft. The whole revolving part is poised, its point bearings merely keeping it concentric. The worm for this shaft is made of a rustless alloy, and is detachable from the shaft. The meter contains from five to six ounces of common commercial mercury, which dissolves a trace of copper from the disc, becoming saturated at once, and a scum forms on the surface, preventing it from further oxidation or sloughing. The magnet is screwed to a thick insulating backboard, and the body is fastened to the magnet by four screws passing up from below into holes tapped into its ends.

The interior leads pass from the posts and the two external ends of the electrodes from the mercury bath, where a junction is accomplished by the ends being first thoroughly amalgamated and then clamped together.

All meters, except the smallest two-wire, are made with heavy low-resistance shunts of proper temperature coefficient to cross the armature circuit.

The cover is made of aluminum left in its natural finish. The back portion of the cover is permanently fixed between the insulating board and two wooden cleats. The two edges of this back sheet are curled forward, forming spring rolls that clamp the edges of the detachable portion of the cover proper when it is pushed back beneath them and the edge of the backboard. The cover proper engages the back portion at the top by overhanging one-quarter of an inch, and is engaged at the bottom by a spring bolt that snaps into place when the cover is pushed back.

The meters are calibrated to read directly in watt-hours from constant-potential circuits of from 100 to 240 volts,

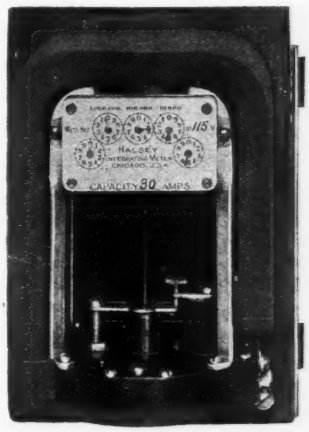


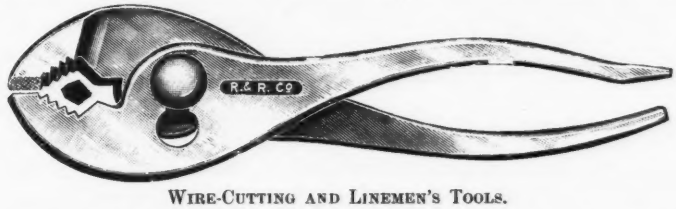
FIG. 3.

and as ampere-hour meters for series arc lights and storage batteries, showing the exact number of ampere-hours charged or retained at any time. All sizes are direct-reading, so that it is not necessary to use a multiplier.

Wire-Cutting and Linemen's Tools.

Smith & Hemenway Company, 296 Broadway, New York city, and the Utica Drop Forge Tool Company, are turning out a fine line of tools, some of which are illustrated in the accompanying engravings. The functions of these tools are very evident from the illustrations, and need not be described except to advance the companies' claim that these are not only made of fine material but are turned out by workmen who thoroughly understand their business, with the results that the tools are always durable and fit for the most efficient service.

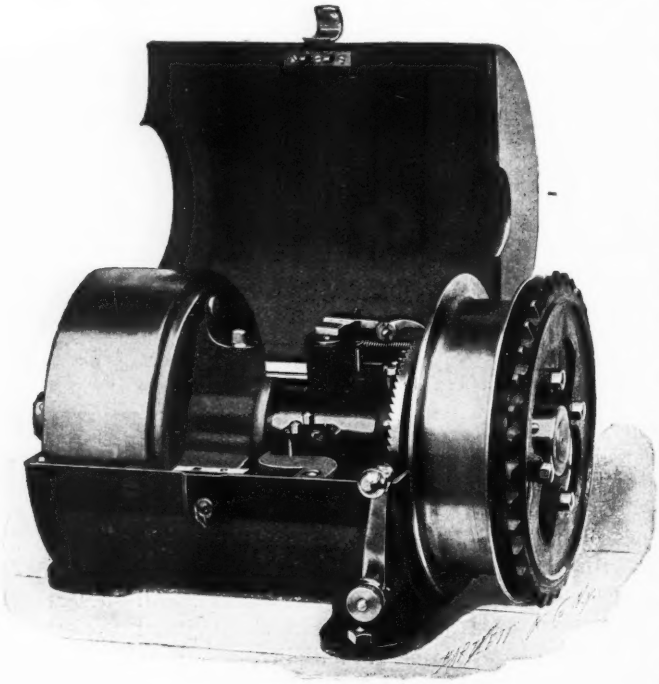
WIRE-CUTTING AND LINEMEN'S TOOLS.



WIRE-CUTTING AND LINEMEN'S TOOLS.

A New Motor-Stop.

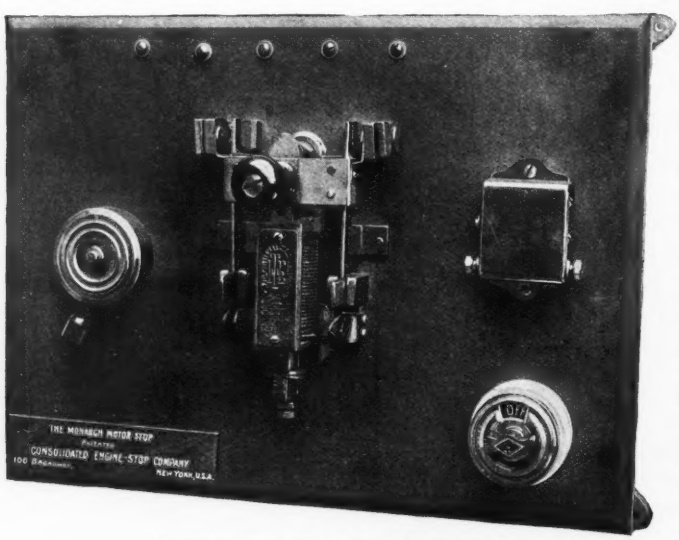
With the increasing use of large units in steam-driven stations, and the growing demand for economy with regard to station attendance, a vital necessity in the form of a quick control of the moving apparatus from any point of the building is becoming recognized more and more. While taking into consideration the very great number of installations which operates year in and year out without accident of any description, from time to time the report goes forth of some disaster occurring because of probably a minor accident at the beginning, making it impossible to shut down the machinery in time to prevent an expanding injury. The bursting of a tube in the boiler room, or the blowing of a supposedly safe valve, or any one of an innumerable list of possible casualties, make it necessary that every precaution should be taken to make safe the condition of the operators, whose environment is more or less fraught with danger.



ENGINE-STOP.

From time to time numerous contrivances have been placed before engineers, the function of which was to effect a complete shutdown either through a self-contained automatic device or by reason of some form of electrical control which could be operated from different points of advantage. Several of these have been used with different degrees of success, and where installed, they have met with ready acceptance, and their operation has been of a very satisfactory nature.

The increase in the use of electric motors for power purposes has now produced a unique, but an exceedingly practical, device for a quick stop in the case of accident. For several years the Consolidated Engine-Stop Company, New York city, has been installing the Monarch engine-stop and speed limit system in hundreds of large plants all over the country where steam is used for power. This latest addition to its speed limiting and quick stopping devices is a Monarch motor-stop, which places an electric motor, or a motor-driven machine, under complete and absolute control from any part of the factory.



SWITCHBOARD FOR NEW MOTOR-STOP.

The new apparatus gives the company a system of power control and speed limiting devices which meets every condition of need or desire for electricity as well as steam-driven machinery. The Monarch engine-stop and speed limit system applied to an engine, the company states, not only prevents absolutely an engine from "racing," but it also provides a means for stopping the engine from any point, or any number of points in the plant, in the case of accident to an employé or the machinery. The motor-stop does the same service for the electric-driven machinery.

Snap switches of the improved dial pattern are placed at different points wherever desired, and one turn of the switch operates a separate battery system which throws the main switch at the board. A bell in the office or engine room, or any part of the plant desired, immediately rings a warning so that the person in charge may know that the power has been shut off. These switches are always available for immediate use, but are protected from meddlesome and unauthorized employés. The switchboard is an attractive sheet of marble or slate carrying a testing apparatus as well as the main switch.

The board itself can be used as a main switchboard or it can be placed in the office or other part of the plant and used only in emergencies. The apparatus can be tested from the switchboard to detect low battery power or short-circuits.

The following are stated by the maker to be prominent features: The system of wiring is patented and is so simple that chances of trouble with it are extremely remote; the cost of the apparatus is infinitesimal compared with its convenience and accident-preventing features; the Monarch motor-stop can be connected to any size motor and any degree of current; it will stop a machine under load in two to five seconds; it can be applied to protect the whole line, or to a limited number of motors, or a single motor.

The Lake Shore & Michigan Southern Railway Company's schedule is so arranged that it will offer excellent facilities for delegates and visitors to the National Electric Light Association convention, to be held in Chicago, May 26, 27 and 28. The trains leaving Buffalo at 3.05, 5.30 A. M., 12.25 noon, 1, 6.25 and 10.55 P. M. run through to Chicago daily. Trains leaving Buffalo at 7.55 A. M. and 11 P. M. run daily. Train leaving Toledo 8.05 A. M. runs daily. The Fast Mail Limited runs daily, leaving New York at 8.45 A. M., arriving at Chicago 7.10 A. M. the next day. The Twentieth Century Limited runs daily, leaving New York 2.45 P. M., arriving at Chicago 9.45 A. M. the next morning. The Western Express leaves New York at 6 P. M., arriving at Chicago 9 P. M. the following evening. The Fast Limited has sleeping cars between New York and Chicago. The Western Express has sleeping cars between New York and Boston to Chicago. The Twentieth Century Limited has two drawing-room sleeping cars from New York to Chicago, eight staterooms, sleeping and observation cars to Chicago. All of the trains have buffet, smoking and baggage cars from New York to Chicago, and dining car accommodations.

An Automatic Under-Feed Stoker.

The accompanying illustrations show two views of the American stoker manufactured by the American Stoker Company, 277 Broadway, New York city. Fig. 1 is a sectional side view, and Fig. 2 is an interior cross-section. This stoker is an automatic, self-contained machine for

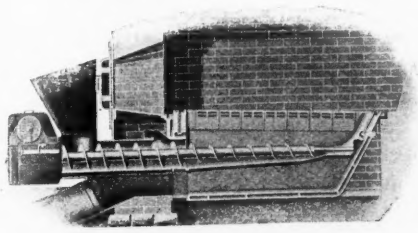


FIG. 1.—SECTIONAL SIDE VIEW.

feeding coal continuously to the furnaces. The stoker is usually operated by a motor supplied by steam through a half-inch pipe. The coal is fed into the furnace from a hopper by a screw conveyor, is pushed upward into the fire, and overflows upon the side grates. The coal in its upward course approaches the fire and is supplied with fresh air entering through tuyères. The air mingles with the released gases and causes them to ignite, this resulting in the gradual coking of the coal. Every pound of coal fed into the hopper passes through this gas and coke-making process.

This apparatus has been found a valuable addition to a steam plant, permitting of many economies, the suppression of smoke is an important factor and one of its many features.

The manufacturer claims that practically perfect combustion is thus obtained, and remarkable results are shown, even

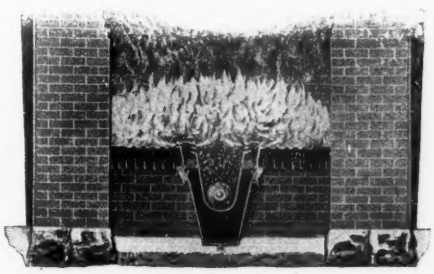
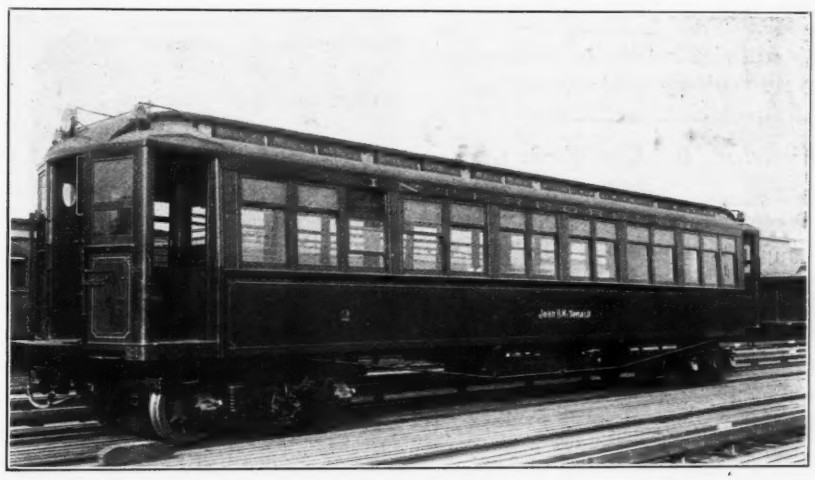


FIG. 2.—INTERIOR CROSS-SECTION.

with very poor grades of coal. This stoker can be applied to any type of boiler or furnace, and a further feature is that no moving part is subjected to heat. These stokers are in operation under boilers aggregating over 500,000 horse-power, and they are also being used in furnaces, forges, driers, etc., in all parts of the United States and Canada.

New Electric Train Control and Couplers.

The Westinghouse company has placed upon the experimental car of John B. McDonald, of the New York Subway system, one of the new electropneumatic unit control systems developed by the Westinghouse Air Brake Company. This apparatus instead of employing a drum controller operated electropneumatically, as in the former type of electropneumatic control, makes use of a series of switches which are individually operated by electropneumatic apparatus of the same character as employed by the Union Switch and Signal Company in operating its electropneumatic signaling system and which have been subjected to years of test in connection with signals on numerous steam railways throughout the country.



EXPERIMENTAL CAR "JOHN B. MCDONALD," EQUIPPED WITH ELECTROPNEUMATIC UNIT CONTROL.

The electropneumatic switches are operated progressively by the valves being so arranged as to admit air to their respective operating cylinders at the right time and rate to ensure graduated acceleration of the train, and also guard against sudden rushes of current. The organization is such that current in excess of a predetermined amount can not be admitted to the motors, from which it results not only that the motors themselves are not subjected to undue strains but the train is free from sudden and abnormal movements in acceleration. The valves may be adjusted so that any required degree of acceleration may be obtained. The details of the apparatus have all been thoroughly worked out and tested in connection with the apparatus of the various Westinghouse companies and have survived long periods of practical operation, so that while the organization of the apparatus in itself is new, it is made up of tried and proven apparatus, thus involving no features of uncertainty as to the practical operation of the new system. The cut shows the appearance of the car equipped with the new control apparatus. It is compact, occupying but a relatively small amount of space and thus not in any way interfering with the braking and other apparatus required to be placed on the car.

There is absolutely no space whatever taken up inside the car by the apparatus. It is all on the platform. When the motorman is not using the platform, the whole thing is folded up against the front partition of the vestibule, so that the entire space then becomes available for the ingress and egress of passengers.

The new control apparatus has all of the usual safety appliances, including the arrangement whereby the current is automatically cut off and the brakes applied, in the event of an accident to the motorman, and its weight is said to be from one-half to three-quarters of a ton per car less than the heavier kind.

An automatic car coupling has also been perfected by which the electric connections and brake pipes are united by the same operation, and it is contended that this new coupling will add not only to the safety of employés but greatly to the facility and convenience in the operation of electric trains.

Formula for Power Necessary to Elevate Water.

The horse-power necessary to elevate water to a given height is found by multiplying the total weight of the water in pounds by the height in feet, and divide the product by 33,000. An allowance of twenty-five per cent should be made for friction in pipe line.

Electrical Engineers for the New York & New Jersey Railroad.

J. G. White & Company have been appointed consulting electrical engineers for the New York & New Jersey Railroad Company, for which Mr. Charles M. Jacobs is chief engineer. Mr. Jacobs is also chief engineer for the proposed tunnels of the Pennsylvania Railroad Company under the Hudson River, and was the chief engineer who supervised the construction of the East River gas tunnel.

J. G. White & Company's connection with this appointment will cover the electrical equipment of the company's tunnels, terminals, rolling stock and equipment, system of electrical conductors, signal and interlocking apparatus, electric lighting of tunnels and terminals, conduits and cables for carrying electric current, and other details connected with the electrical equipment of the New York & New Jersey system. This will also include the elevators, ventilation and heating of the terminals.

Electricity for Gas Works Operation.

An interesting gas power plant is now being installed at the works of the Milwaukee Gas Light Company, Milwaukee, Wis. The company is erecting a new gas works which will be one of the largest in the country, and will embody the most advanced practice in modern gas engineering. Although no electricity will be generated for outside lighting, a gas engine driven electrical plant will be employed for furnishing motive power to the various auxiliaries throughout the works, all of which will be operated by electric motors; a large machine shop will also be operated by electric motors. Coal will be unloaded from boats elevated to the storage bins by electrical hoists and conveyors, the retorts will be charged and drawn by electrical appliances, and the final disposition of the coke will be accomplished by means of electric power apparatus. The entire electrical distribution system will operate at 250 volts direct current from a central power generating plant, employing gas engines connected directly to the gas mains.

The present equipment comprises one 250-horse-power Westinghouse, horizontal, double-acting gas engine, driving a 150-kilowatt generator, and three 125-horse-power vertical engines belted to 75-kilowatt generators. Provision has been made for future extensions of the equipment with a second power unit of the former type. The 250-horse-power engine is of the new horizontal type, recently introduced by the Westinghouse company for general power work. Its principal features are a pair of horizontal cylinders arranged in tandem, and operating upon the double-acting principle, a single-crank and water-cooled pistons, cylinders and combustion chambers. The engine is particularly adapted to generator driving by reason of its excellent speed regulation, due to the method of governing employed, which at each stroke proportions the explosive charge to the load, but maintains at all times a mixture of constant quality.

A Twenty-Ton Switching Electric Storage Battery Locomotive.

The electric storage battery locomotive described below has been designed with special reference to the economical handling of material in mills or other manufacturing establishments. It frequently happens that a single carload of raw material has to be distributed at various parts of the works, and, in such cases, much costly rehandling can be saved by shifting the entire car from point to point, and discharging each portion of the load exactly where it is required. A similar economy can be effected by collecting the finished product at the different buildings, and loading each consignment directly into its proper car. The locomotive in question is used for shifting cars while loading or unloading in this manner, and also for transferring material, in course of construction, from one shop to another.

The simple and rugged construction of this locomotive reduces the expense for maintenance to a minimum, probably less than the cost of shoeing the horses, which it replaces. The operating expenses consist of the cost of power required to charge the batteries, and the pay of one man. Even if charging current is supplied from an independent steam-driven generator, it is cheaper than any other method of handling cars, as there is no waste of energy when the machine is not in operation. A steam locomotive requires a licensed engineer and an assistant to operate it, and it greatly increases the fire risk.

The disastrous consequences which can result from the sparks of a steam locomotive when used near highly inflammable material are illustrated by a recent explosion at the plant of the Northwestern Star Oil Company in Minneapolis, in which eight men and two women lost their lives. The explosion is believed to have been caused by the sparks from a switch engine, which ignited some oil, while it was being transferred from the tank cars to the tanks in the basement of the wrecked building. In cotton mills the danger is fully as great, owing to the great inflammability of the material handled.

A further advantage of the storage battery locomotive is that it can be run on any track or switch without the expense of the erection and maintenance of a trolley wire.

A locomotive of this type has recently been installed at the works of the Massachusetts Cotton Mills in Lowell, Mass. The original buildings have been improved and extended to meet the requirements of the growing business, and new structures have been added, from time to time, until the entire plant covers a considerable area. The freight siding is separated from one of the two principal storehouses by the main business street of the city, and from the second of these storehouses by the canal which supplies the turbines of the mill. It is necessary to deliver carloads of baled cotton at either or both of these buildings. Neither a steam nor a trolley electric locomotive is permissible in the storerooms on account of the fire risk.

Before installing the locomotive, the cars were shifted, one at a time, by three horses harnessed up tandem. The storeroom at the canal is so constructed that the horses would have no means of exit if driven in ahead of the car, and this necessitated sending it in "on the fly." The bridge across the canal is just wide enough for the car tracks, and the horses had to turn out before reaching it. To get up speed, it was necessary to start some distance up the track, the "tag holder" (the man at the coupling), the driver and the horses all traveling at their best gait. At the proper moment, the "tag holder" unhooked the "tag" or rope fastened to the traces, and ran out from in front of the car. The consequences of a slip or false step are self-evident. In the case of a heavily loaded car, the horses were unable to give it sufficient momentum, and the operation had to be completed by a loading gang pushing the car to its destination.

The locomotive is shown in Fig. 1.

This locomotive is built for the standard four feet, eight and one-half inches gauge, and fitted with M. C. B. standard couplings, making it suitable for use with any ordinary railroad car, and on any standard railroad track. The length over the

bumpers is twenty-one feet four inches, and the height from the railhead to the top of the cab is twelve feet one inch. The wheel base is seven feet six inches, and permits the operating of the locomotive over a comparatively smaller turntable. It weighs about twenty tons, and runs at a speed of from two to four miles per hour on level track.

As will be seen from Fig. 1 the locomotive is "double ended," the cab being located directly in the centre. This makes a very desirable arrangement for switching work, which calls for operation in both directions with equal facility. The

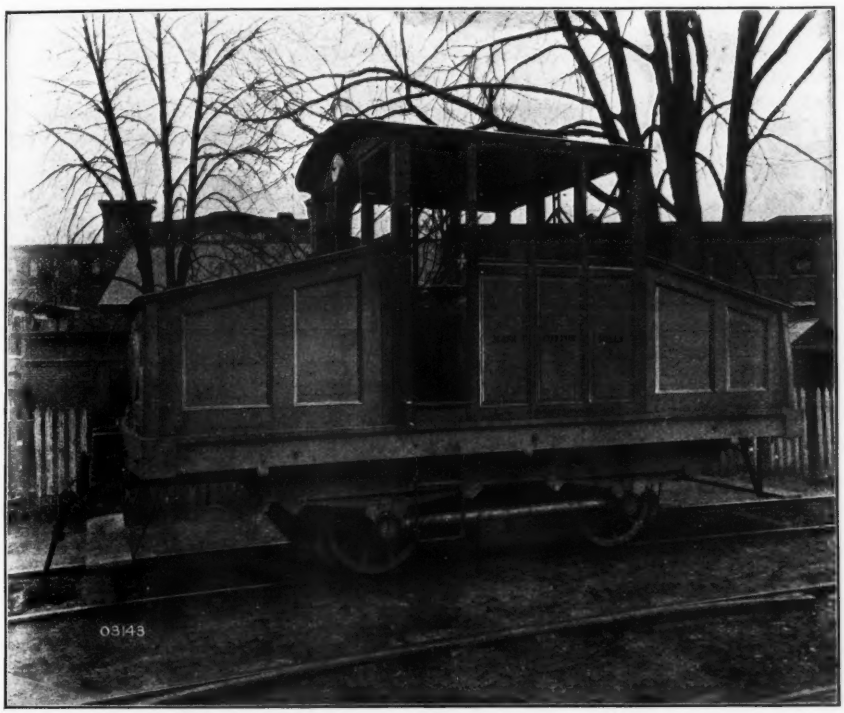


FIG. 1.—STORAGE BATTERY SWITCHING LOCOMOTIVE.

batteries are contained in the sloping compartments at either end. This symmetrical disposition distributes the weight evenly on the four wheels, and, as each of these is a driver, the entire weight of the locomotive is usefully employed in traction. The wheels and axles are driven from the gear cases in the cab by means of Renold silent chains suitably enclosed. These chains are the only portions of the driving gear situated below the car body, the motors and gear cases being mounted in the cab where they are readily accessible, and always under the immediate notice of the operator. Under these favorable conditions, any reasonably reliable man can be depended upon to maintain the electrical equipment in proper working condition. This is considered a most important feature of the design, as it is a matter of common experience that any inaccessible piece of mechanism will be run with no attention until it finally refuses to operate. When such condition is reached, a complete shutdown is necessary to enable more or less costly repairs to be made by an expert electrician or mechanic.

The battery was furnished by the Electric Storage Battery Company, Philadelphia, Pa., the elements being mounted in tanks of extra depth to prevent the electrolyte from splashing over the top. In mounting the battery, special attention has been paid to protecting it against injury due to the shock to which the locomotive is exposed in switching.

There are two motors, specially wound, for the service. By connecting the two motors in series or parallel, and by varying the arrangement of the fields, an efficient speed control is obtained without wasting any of the energy of the battery by passing it through a resistance.

The controller is of the standard vehicle type, and has two levers which control every desired motion of the locomotive. The reversing lever is set to point in the direction in which the locomotive is to move, and the second lever controls the speed. These levers are mechanically interlocked, as in the case of a trolley car controller, so that the motors can only be reversed when the speed lever is in the off position. The locomotive may be run with the controller in any notch, there being no transition point on which a careless operator might leave his lever and burn out the apparatus.

As already mentioned, the speed-reducing gearing is located in the cab, instead of being beneath the car body. All the gears are machine cut, and run in a bath of oil, in fully enclosed gear cases of the C. W. Hunt Company's standard type. The same company's regular flexible and insulated coupling is used for connecting the motor to the gear case. There is a separate gear case for each of the two motors. It will be seen that the driving gear consists of two parts which are exact duplicates of each other. In an emergency, one motor could be cut out entirely, and the locomotive operated by the remaining motor, but with a reduction of hauling capacity.

The speed reduction of the gear case is so proportioned to the safe discharge rate of the batteries, the safe capacity of the motor, and to the weight of the locomotive, that neither the batteries nor the motors can be dangerously overloaded.

The driving axles are made to the M. C. B. standard dimensions, and run in "Hunt" patent roller bearings, which reduce the friction at these points to an inappreciable amount. The wheels are shrunk in place, and have chilled treads and flanges of M. C. B. standard size and shape. A powerful brake is conveniently located in the cab. An alarm gong is also provided.

Experience has shown that in light switching service, the batteries can be recharged at various times during the day while the locomotive is waiting between hauls. For heavier service, it may be necessary to charge during the noon hour or after working hours in the evening. The battery is automatically protected during charging by well-known safety appliances which open the circuit if the current is excessive, and also when it drops so low as to indicate that the battery is fully charged. The precise arrangement of the charging station depends very largely on the details of the electric plant available, and the builders of the locomotive are glad to advise their customers as to the methods to be employed in each particular case.

This locomotive is placed on the market by the C. W. Hunt Company, of West New Brighton, Staten Island, N. Y. Smaller locomotives, intended for use on the "Hunt" narrow-gauge track, have been built by the same company for a number of years.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW TELEPHONE COMPANY ORGANIZED—The Columbus (Ga.) Automatic Telephone Company has been organized with a capital stock of $1,000,000. The contract has been let by the directors to the Southern Telephone Construction Company to construct the system, and it is stated that work has already been begun. The following officers have been elected: John T. Norman, Columbus, president; C. B. Lloyd, Toledo, Ohio, vice-president; Frank Hart, Toledo, Ohio, treasurer, and George B. Young, Columbus, secretary.

AN OHIO ELECTRIC MERGER—It is announced that a consolidation of the Columbus Railway Company, owning and operating the local street lines, and the Edison Electric Light Company, of Columbus, Ohio, the leading electrical company of the city, has been practically completed. A holding company with a capital of $5,000,000 will be formed to operate the two concerns. Arrangements are being made for the transfer of stock, but those stockholders retaining their holdings in the two companies will be guaranteed certain dividends.

CONNECTICUT POWER PLANT—A tract of land near Plainville, Ct., containing six and one-half acres, has been purchased for the site of the power-house for the Connecticut Railway and Lighting Company. The power will be furnished by the New Milford Power Company, which has been formed under the management of Mr. Nicholas M. Staub. The plant will utilize the power of the Housatonic River. Current will be carried by cable from the lower part of Litchfield County to the power-house in New Britain, and from this point will be distributed to the various substations of the company, it being also planned to supply New Britain with motive power both for trolley cars and electric lights.

NEW JERSEY TROLLEY COMPANY FILES INCORPORATION PAPERS—The articles of incorporation of the Public Service Corporation, of New Jersey, have been filed in the county clerk's office at Newark, the company being capitalized at $25,000,000. The new corporation was organized by the Fidelity Trust Company, to take in the North Jersey Street Railway Company, the Elizabeth & Plainfield Railway Company, the White Line, the Passaic & Orange Valley Street Railway Company, and the United Electric Company. The incorporators are: Thomas Dolan, president of the United Gas Improvement Company, of Philadelphia, Pa.; John I. Waterbury, president of the Manhattan Trust Company, and Thomas N. McCarter, who is to be president of the new corporation.

NEW YORK BOARD OF ALDERMEN BLOCKS THE UNION RAILWAY COMPANY—One of the most important franchises granted during Mayor Low's administration in New York city was nullified at a meeting of the board of aldermen last week. The contest arose on the favorable report of the railroad committee on the application of the Union Railway Company to lay tracks across Macomb's Dam bridge. On vote the franchise was defeated, and can now come up only as new matter sent from the board of estimate to the aldermen. This not only affects the Union Railway Company, but also affects the Interurban franchise, in which there is a clause allowing this company to cross Macomb's Dam bridge on the tracks of the Union Railway Company, it being understood that at the present time the Interborough company has no right to lay tracks on the bridge.

LEGAL NOTE.

POLYPHASE INDUCTION MOTOR PATENTS—On Saturday, May 2, 1903, the United States Circuit Court for the Southern District of Ohio, issued a restraining order against the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, restraining it from manufacturing or dealing in alternating-current polyphase induction motors, which it is held are infringements of the Tesla patents of May 1, 1880, now owned by the Westinghouse Electric and Manufacturing Company.

ELECTRIC LIGHTING.

MIFFLINGSBURG, PA.—The council has voted to establish a $10,000 electric light plant.

SILVERTON, COL.—The new municipal electric light plant has been put in operation. It cost $30,000.

SAND POINT, IDA.—The council has granted a franchise to M. R. Rutherford, of Missoula, to establish an electric lighting system.

BOSTON, MASS.—The Malden Electric Company is to enlarge its plant so as to secure 14,000 feet of floor space. The work will cost over $100,000.

SAYVILLE, N. Y.—The Sayville Electric Light Company is extending its lines through Bayport, and will install its system in the new railroad depot there.

YOUNGSTOWN, OHIO—The Youngstown Consolidated Gas and Electric Company is making additions to its plant which will give it an additional 1,400 horse-power.

ZANESVILLE, OHIO—The contract for the erection of the Zanesville Railway, Light and Power Company has been let, the contract providing that the work shall be completed by July 15.

CINCINNATI, OHIO—The stockholders of the Cincinnati Gas and Electric Company have authorized an increase in the capital from $29,000,000 to $31,000,000, the money to be used for plant improvements.

BURLINGTON, WIS.—The Burlington Electric Light and Power Company has been incorporated with a capital of $50,000, the incorporators being L. J. Smith, C. E. Partee and Mary D. Smith. The plant will furnish power for several factories here.

HEPPNER, ORE.—An electric light plant, to cost about $18,000, will, it is stated, be installed fifteen miles south of this city this summer, deriving power from Willow Creek. A. M. Slocum is planning the enterprise, and power will be transmitted to this place.

GUTHRIE, KY.—To secure the establishment of an electric light plant the Guthrie town council proposes to furnish a franchise and a free site for twenty-five years, to release the plant from taxation for five years, and to donate $1,000 in cash to the enterprise.

INDEPENDENCE, ORE.—Arrangements have been made by which the Independence & Monmouth Water and Electric Light Company will light the city's streets for five years, and also supply it with water. It is expected that many improvements will be made in the service.

CINCINNATI, OHIO—The Cincinnati & Columbus Traction Company will locate its power-house at Perinton, Ohio. It is estimated that the plant will cost the company about $200,000. The company will also have four substations that will cost $25,000, to be located at several points between Norwood and Hillsboro, Ohio.

LAUREL SPRINGS, N. J.—The Electric Light Company, of the Township of Clementon, has been incorporated, with Jacob Ludy, president; Henry W. Bassett, vice-president; Joseph Borden, secretary; Horatio Church, treasurer. The company will light the towns of Laurel Springs, Overbrook and Linderwold, and work is to be commenced at once.

TROY, N. Y.—The Schaghticoke Electric Company has been incorporated by George E. Greene, I. E. Gibson, E. H. Libby, Frank H. White and H. J. Greene, with a capital of $30,000, which is to be largely increased. The object of the company is to develop a water power about one mile below Schaghticoke village, where it is thought 5,000 horse-power can be secured.

ST. PAUL, MINN.—The city council has granted the Western Gas and Investment Company a thirty-year franchise to furnish

electricity, and it is expected that the above-named company will at once acquire the plants of the Stillwater Gas and Electric Light Company and the Apple River Power Company. The Western company will expend nearly $100,000 in improvements and construction, and a good share of the work will be done this season.

MEMPHIS, TENN.—The Memphis Consolidated Gas and Electric Company, recently formed through the merger of the Equitable Gaslight Company and the Memphis Light and Power Company, and capitalized under the laws of New Jersey at $4,000,000, has been granted permission by the legislative council of this city to extend its conduit system at a cost of $93,000. The work will be undertaken at once.

YORK, PA.—The York Haven Water and Power Company has almost completed its plant. Electricity will be supplied to York, Harrisburg, Lancaster, Columbia, Steelton and many other cities in this section of the state. If desired, the current can be transmitted to a distance of 200 miles. The completed works will cost over $1,000,000. The officers of the company are: President, H. L. Carter, New York; vice-president, W. Bay Stewart, New York; secretary, Samuel Mason, Philadelphia; treasurer, H. L. Stokes, New York.

PERSONAL MENTION.

MR. JOSEPH B. HALL, recently sales representative of the power and mining department of the General Electric Company, Chicago, Ill., has been appointed chief engineer of the McGuire Manufacturing Company, Chicago, Ill.

MR. ARTHUR WARREN, manager of the Westinghouse Companies Publishing Department, returned last week to New York after several months' absence in London and on the Continent. The Westinghouse interests in foreign countries are quite active and rapidly increasing, the extensive new works at Manchester, England, are running under full headway.

MR. V. H. YARNALL, manager of the American Vitrified Conduit Company, Broadway-Maiden Lane Building, New York city, is on his way to Russia to superintend the laying of the conduit for the St. Petersburg municipal telephone system. This contract was awarded by the St. Petersburg city council, and the articles call for all the conduit that can be laid this summer, the minimum being stated as 1,000,000 duct feet. About 900 tons or 220,000 feet of two-duct conduit, twenty-four inches long, have already been shipped. Mr. H. B. Thomas, assistant manager, will be in charge of the New York office, Mr. S. A. Douglass acting as sales manager.

MR. E. H. ABADIE, St. Louis, Mo., has been elected vice-president of the Elblight Company of America, of which company Mr. Russell Spaulding is president. Mr. Abadie is well known in the electrical and allied fields, and a host of friends will wish him success in his new appointment. While he has been more or less a pioneer in many branches, his prominent association with the sales department of the Wagner Electric Manufacturing Company, of St. Louis, Mo., and later as manager of the sales of the Wagner-Bullock Electric Manufacturing Company's organization, and his successful management of a large personal business in St. Louis, have established him very firmly in the esteem of a large clientele. Mr. Abadie has recently closed a contract for all the lead covered and underground cable for use at the Louisiana Purchase Exposition, amounting to $225,000, for the Safety Insulated Wire and Cable Company.

OBITUARY NOTICE.

MR. JOHN FORNEY STAUFFER, president of the George C. Towle Manufacturing Company, Lancaster, Pa., died on Saturday, May 2, 1903. Mr. Stauffer was born in Penn Township, August 6, 1845, his ancestors coming from Switzerland about 1790. Previous to entering into the electrical business, Mr. Stauffer was a contractor for railroads, waterworks, etc., and many prominent engineering installations were accomplished by him in eastern Pennsylvania. Mr. Stauffer has had two sons—Charles F., a prominent contractor of Lancaster, Pa., and B. Grant, secretary and treasurer of the George C. Towle Manufacturing Company. He was president of the American Spring Water Company, besides being president of the George C. Towle Manufacturing Company, and was also a member of several social orders.

ELECTRICAL SECURITIES.

With the coming of the warm season, the hope held out in many quarters for a more active speculative interest is being shattered. While many inducements are being offered to the buying public to subscribe more liberally, the commission offices are experiencing a decided drag in business. Early in the week there was apparently a movement which, in its initial condition, gave promise of going a great way toward lifting up the market in general; but this proved merely spasmodic, and resulted in the public being again frightened and driven from the market by reason of several adverse contingencies. Another condition which, though not given serious consideration in many directions, is yet of sufficient moment to attract attention, is that many of the individuals who have been largely responsible for all of the activity which the market has shown for some time, are now out of town, and are showing little interest in the positive developments of the day. If this condition is prolonged for but a short time, there is every reason to believe that the season will drag along with very little fluctuation in prices, during the summer months at least.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 9.

New York:	*Closing.*
Brooklyn Rapid Transit	65½
Consolidated Gas	209½
General Electric	193¾
Kings County Electric	190
Manhattan Elevated	141¾
Metropolitan Street Railway	132
New York & New Jersey Telephone	164½
Westinghouse Manufacturing Company	213

The directors of the Consolidated Gas Company have declared the regular quarterly dividend of 2 per cent, payable June 15. Books will close May 27 and reopen June 16.

The board of directors of the Metropolitan Securities Company, the holding company formed to provide present and future needs of the Metropolitan Street Railway Company, has voted to make a call of twenty-five per cent upon subscription to the company's stock, payable June 10, 1903, thus making the stock 50 per cent paid. The Metropolitan Securities Company is capitalized at $30,000,000. All the stock is outstanding, and only 300 shares held by the incorporators have been fully paid.

Boston:	*Closing.*
American Telephone and Telegraph	157
Edison Electric Illuminating	272
Massachusetts Electric	88
New England Telephone	137½
Western Telephone & Telegraph preferred	96

New England Telephone and Telegraph directors have been re-elected.

Philadelphia:	*Closing.*
Electric Company of America	8⅞
Electric Storage Battery common	72
Electric Storage Battery preferred	72
Philadelphia Electric	7
Union Traction	46
United Gas Improvement	95½

The annual report of the United Gas Improvement Company shows net profits for the fiscal year ended December 31, 1902, of $3,473,643, an increase of $938,354 over the previous year. All of the old officers have been reelected.

Chicago:	*Closing.*
Chicago Telephone	156
Chicago Edison Light	150
Metropolitan Elevated preferred	74
National Carbon common	24
National Carbon preferred	95
Union Traction common	4
Union Traction preferred	22½

The annual report of the Chicago Edison Company for the year ended March 31, 1903, shows gross earnings of $3,409,576, and operating expenses of $2,195,647, leaving net earnings of $1,213,929. Interest and dividends amounted to $894,336, leaving a surplus of $319,593, as compared with $268,824 for the preceding year.

NEW INCORPORATIONS.

MACON, MICH.—Macon Telephone Company. $3,000.

OGDEN, IOWA—The Ogden Telephone Company. $25,000.

RUSHVILLE, ILL.—Rushville Telephone Company. $5,000.

INGLEFIELD, IND.—The Rural Telephone Company. $1,000.

AVONDALE, PA.—Avondale Borough Electric Company. $5,000.

SPRINGFIELD, ILL.—Graymont Telephone Company. $2,500.

WAKONDA, S. DAK.—Wakonda Telephone Company. $10,000.

EVERETT, PA.—The Bedford-Fulton Telephone Company. $5,000.

INDIANAPOLIS, IND.—The Mooresville Telephone Company. $12,000.

WEST GROVE, PA.—West Grove Borough Electric Company. $10,000.

LANSING, MICH.—Calumet Heat, Light and Power Company. $80,000.

SHENANDOAH, PA.—People's Electric Light Company. $20,000.

SOUTH BETHLEHEM, PA.—Consumers' Heat and Power Company. $5,000.

KENNET TOWNSHIP, PA.—Kennet Township Electric Company. $10,000.

LITCHFIELD, MICH.—Litchfield Farmers' Mutual Telephone Company. $2,000.

LANSING, MICH.—Blissfield Telephone Company. Increased from $7,000 to $25,000.

ALLENTOWN, PA.—Fountain Hill & West Bethlehem Heat and Power Company. $5,000.

MOUNT HOLLY, PA.—Mount Holly Springs Light, Heat and Power Company. $5,000.

CAMDEN, N. J.—The Clementon Township United Electric Improvement Company. $100,000.

COLUMBUS, OHIO—The Hannibal & Round Bottom Telephone Company. Increased to $2,500.

MILWAUKEE, WIS.—The Johnson Electric Service Company. Increased from $800,000 to $1,000,000.

AUGUSTA, ME.—Marquette Electric Company. $100,000. Incorporators: F. L. Dutton and E. F. Whittum.

WOODSTOCK, ME.—Curtis Hill Paris Telephone Company. $10,000. Incorporators: F. H. Packard and F. L. Wyman.

TRENTON, N. J.—The National District Telephone Company. $100,000. Incorporators: S. W. Slayer, James H. Reid, B. A. Judd, R. W. Beard.

ST. LOUIS, MO.—The Chouteau Gaslight, Heat and Power Company. $150,000. Incorporators: Stanley D. Pearce, G. S. Hoss and Manton Davis.

WORCESTER, MASS.—The Greene Electric Light, Power and Manufacturing Company. $16,000. Incorporators: Charles H. Greene and Alonzo A. Carr.

PRESCOTT, ARIZ.—The National Chemical Power Company. $25,000,000. Incorporators: John H. Carruthers, Otto Koehler and Oscar Bergstrom, all of New York.

REXBURG, IDA.—The Fremont Power Company, Limited. $50,000. Directors: John E. Pincock, Eli McIntire, John L. Jacobs, Henry J. Flamm and Ross J. Comstock.

GLOUCESTER, MASS.—Manchester Electric Company. $116,500. Directors: Oliver T. Roberts, George C. Lee, Jr., Gardner M. Lane, Charles E. Cotting, Philip Dexter and Raymond C. Allen.

FORT WAYNE, IND.—The Fort Wayne & Northeastern Traction Company. $100,000. Incorporators: Charles S. Karoly, R. S. Robertson, W. S. O'Rourke, John Haberly and George W. McKee.

RICHMOND, IND.—Richmond & Northwestern Traction Company. $50,000. Incorporators: G. N. Hodges, Dayton, Ohio; G. G. Bombach, Dayton, Ohio; L. T. Lowman, Dayton, Ohio, and W. R. Riddell, Xenia, Ohio.

TELEPHONE AND TELEGRAPH.

CLEVELAND, OHIO—The Cuyahoga Telephone Company will reduce its capital one-half to $1,500,000.

LISBON, OHIO—The Eastern Ohio Telephone Company, with headquarters at East Rochester, has increased its capital stock from $5,000 to $25,000.

WEST HOPKINTON, N. H.—The West Hopkinton Telephone Company has been organized, with C. S. Rowell, president; W. B. Barton, secretary; J. S. Straw, treasurer.

DUNDEE, N. Y.—The citizens of Wayne have organized a telephone company, and will extend a line from that place to Keuka, where it will connect with the Bell system.

PONTIAC, MICH.—The Livingston Home Telephone Company has been granted a franchise to erect poles, string wires and establish an exchange in the village of South Lyon.

DES MOINES, IOWA—The Apponoose County Telephone Company has been incorporated with a capital of $60,000. C. A. Farrington is president and E. E. Bamford, secretary.

PRESTON, IOWA—The Jackson Telephone Company has been merged into a corporation of $25,000 capital. N. J. Millhaem is president and F. V. Potter, secretary and treasurer.

COVINGTON, IND.—The Veedersburg Telephone Company, with $25,000 capital, has been incorporated by John L. Osborn, J. K. Quinn, D. P. Heffner, J. M. Osborn and Charles E. Osborn.

HANNIBAL, MO.—The Hannibal & Ralls County Telephone Company has been incorporated with the Secretary of State with a capital of $1,000. The line of the company has just been completed.

ELKTON, MD.—Plans have been completed for the incorporation of a new long-distance telephone company, which will conduct and operate long-distance telephone lines extending from Elkton to Crisfield, Md. The capital stock will be $75,000.

WARREN, OHIO—The Phalanx & Leavittsburg Telephone Company has completed arrangements whereby it will extend its line from Phalanx Station to Braceville Center, and probably to Newton Falls, three miles further south, connecting with the local system there.

ALBANY, N. Y.—The Red Jacket Telephone Company has been incorporated with the Secretary of State to construct a telephone line connecting, from the village of Shortsville, the villages of Manchester, Clifton Springs, Victor, Canandaigua, Palmyra, and other immediate points in Ontario, Wayne and Seneca.

HARRISBURG, PA.—Capitalists in Johnstown and Pittsburg have formed a new telephone company with a capital of $70,000, to build connecting lines between Altoona and Johnstown, and Pittsburg, Blair, Cambria, Fayette, Allegheny, Indiana, Westmoreland and Somerset counties will be benefited. Work has already begun.

ALLIANCE, OHIO—The Pennsylvania Railroad Company has arranged for installing a separate telephone system for the use of the company. It will have a central at the depot, with lines connecting with the ticket office, freight office, yard office, and with the company's offices in Pittsburg, Conway, Wellsville, Cleveland and Crestline.

MECHANICSVILLE, N. Y.—The Eastern Electric Construction Company is now erecting a line of poles and stringing wires from this village to Stillwater, for the joint use of the Halfmoon Light, Heat and Power Company, which will hereafter light the streets of Stillwater, and the Saratoga Telephone and Telegraph Company, which will establish an exchange in Stillwater as soon as its lines are extended to that place.

LAKE CRYSTAL, MINN.—The several township telephone companies in the vicinity of this place have merged under the name of the Minnesota Farmers' Mutual Telephone Company, with the following officers: Dan Williams, president; G. A. Holtergreen, secretary; J. T. Lewis, W. S. Hughes, R. S. Hughes, T. L. Rodgers and D. Little, directors. The company plans upon having a line 100 miles long at the start, and connecting with the local systems at this place and Mankato. Operations are to begin at once.

ELECTRIC RAILWAYS.

UTICA, N. Y.—Work on the Syracuse and Auburn trolley line will be resumed at once, and its promoters say cars will be running about May 1. The power plant in Auburn will be ready before the line is completed.

OTTAWA, ILL.—The capital stock of the Joliet & Northwestern Electric Railway Company will, it is stated, be increased from $500,000 to $1,200,000, and work begun. Of this amount, $245,000 is to be expended in building the road.

WASHINGTON, PA.—The Western Street Railway Company, of Pittsburg, will build a trolley line from Finleyville to this place, to connect with the Pittsburg & Charleroi line at Finleyville. The road will connect Washington and Pittsburg by trolley.

TRENTON, N. J.—Surveyors are at work on the projected trolley road of the Delaware Valley Traction Company, which is to connect Trenton and Lambertville. Construction will be started so that the line can be completed during the coming summer.

DETROIT, MICH.—The Detroit, Monroe & Toledo Short Line has begun the work of constructing its line from Monroe to Detroit, which, together with the equipment, will involve an expenditure of $1,000,000. The road is expected to be thoroughly equipped and in operation by next October.

BINGHAMTON, N. Y.—Work on the proposed electric road of the Intervale Traction Company, to run from Goshen to Newburgh, will be commenced as soon as possible this spring. The road, which is capitalized at $300,000, will touch Chester, Greycourt, Blooming Grove, Salisbury Mills, Moodna and New Windsor.

ANDOVER, N. Y.—New York capital, together with local capital in Hornellsville, Alfred and Almond, has organized the Allegany Electric Construction Company, and plans to build a trolley line from Hornellsville to Alfred after the rights of way have been secured and the franchise granted. The capital of the company is $150,000.

INDIANAPOLIS, IND.—The St. Joseph Valley Traction Company, with a capital of $200,000, has been incorporated. The company will build an electric line from Lagrange to South Bend. The directors are: Rollin Ellison, M. V. Beiger, James A. Roper, F. S. Fish, A. H. Beardsley, W. B. Pratt, S. Maxon, C. H. Winchester and H. E. Bucklen.

FLORENCE, ALA.—The city council has granted franchises to J. W. Worthington and associates for the right of way through the streets of Florence for the electric car line to run from Tuscumbia and Sheffield, and for the lighting of the city. The franchises cover a period of thirty years, and require that the work shall be completed in eight months.

YOUNGSTOWN, OHIO—The Youngstown & Ohio River Railway and Light Company has been capitalized by Cleveland and Youngstown capitalists, and will soon have this section of the state gridironed with electric lines running from this city to the Ohio River. The officers are as follows: President, T. W. Hill; vice-president, William Christy; secretary, Max P. Goodman.

YORK, PA.—Plans are well under way for the building this summer of an extension of the York County Traction Company's lines into the Springetsbury Valley to Hellam, and across country to take in Yorkana, East Prospect and Long Level, possibly completing the extension as a loop around to connect with the Red Lion-Windsorville line at one of those two towns. Rights of way are now being secured.

MORGANTOWN, W. VA.—By authority of franchises granted by the county courts of Monongahela and Marion counties, the Fairmont, Morgantown & Cheat River Railroad Company will at once begin the construction of a trolley line connecting Fairmont, Morgantown and the Cheat River Valley with the Pittsburg, McKeesport, Connellsville and Union companies line. The line will cost half a million dollars.

KOKOMO, IND.—At a meeting of the stockholders of the Kokomo, Marion & Western Railway Company, held recently, it was decided to increase the capital stock from $10,000 to $1,000,000, and a notice to that effect has been filed with the Secretary of State. The following officers were elected: George J. Marott, president; L. J. Kirkpatrick, vice-president; George E. Bruner, treasurer; T. C. Reynolds, secretary.

WILMINGTON, DEL.—It is stated that the Wilmington & Kennett Square section of the trolley road that will eventually connect West Chester and Wilmington may be put into operation by June 1, the West Chester-Kennett section to be completed later. Between this city and Kennett the road will pass through Brandywine Springs, Hockessin, Yorklyn, Toughkenamon, Clifton Mills and Unionville.

BLOOMINGTON, ILL.—Articles of incorporation have been filed by the Dixon, Rock Falls & Southwestern Electric Railway Company, with its principal office located at Rock Falls. The capital of the concern is $50,000, and the object is to construct a line from Dixon, Lee County, Ill., to Rock Island, Rock Island County, Ill. The incorporators are O. E. Maxson, A. S. Goodell, A. J. McNeil, E. L. Leitch and B. L. Sheldon, all of Rock Falls, Ill.

MUSKEGON, MICH.—The West Michigan Interurban Railway Company, which will build an electric railway from Grand Rapids to Hart, *via* Muskegon, has been organized, with a capital stock of $100,000. The directors of the company are: G. S. Johnson, E. M. Deane, F. A. Nims, Frank Wood, M. B. Covell, J. J. Gee, F. J. Russell, C. L. Churchill, W. E. Osmun. The road will be 100 miles in length, and it will follow a private right of way, except in the cities and villages, where it will use the public streets.

GREENSBURG, PA.—The Mount Pleasant, Pleasant Unity & Baggaley Electric Street Railway Company has been chartered with a capital of $100,000, to build an electric road connecting Mount Pleasant and Baggaley. Work will be commenced as soon as the necessary arrangements have been completed. The road will be sixteen and one-quarter miles in length, and will touch the villages of United, Trauber, Pleasant Unity, Whitney and Lippincott. At Baggaley the line will connect with the electric line from Latrobe.

AUGUSTA, GA.—The Augusta & Columbia Electric Railway, with a capital of $20,000, has applied for a charter. The directors state that it is proposed to build the line in the counties of Richland, Lexington and Aiken, and it will be fifty miles in length. At Aiken it will connect with the Augusta-Aiken line, giving a through route from Columbia to the former city. The incorporators are: James U. Jackson and W. M. Jackson, of Augusta; W. B. Smith Whaley, E. B. Clark and W. H. Lyles, of Columbia, and Henry Buist, of Charleston.

INDIANAPOLIS, IND.—The Toledo & Chicago Interurban Railway Company has filed articles of incorporation with a capital of $500,000. The directors of the company are Frederic B. Perkins, Frank E. Seagrave, Charles W. Ryan, Arthur B. Shepard, Frank L. Welsheimer, Roddell D. Murray and Edward B. Johns. The company purposes to build a road from the east boundary of DeKalb County, Ind., across DeKalb, Steuben, Allen, Elkhart and Kosciusko counties, through Butler, Waterloo, Auburn, Garrett and Altona, DeKalb County; Hamilton, in Steuben County; Huntertown and Fort Wayne, in Allen County; Avilla, Kendallville, Albion and Ligonier, in Noble County; Goshen, in Elkhart County, and Syracuse, in Kosciusko County; also other branches. J. E. and J. H. Rove, of Auburn, filed the articles.

WILKESBARRE, PA.—Plans have been completed for the construction of a new road known as the Scranton, Factoryville & Tunkhannock Railway, and work will commence within six weeks. The officers and directors of the company are: J. Selden Swisher, president; J. P. Dickson, vice-president; Lewis B. Carter, treasurer; A. B. Dunning, chief engineer. Directors: J. Selden Swisher, James P. Dickson, Lewis B. Carter, Fred B. Scott, Robert Wilson, Charles E. Swisher, J. F. Briggs, Charles W. Seeley, all of Scranton, and J. B. Knecht, of this city. The intention is to construct a road with branches to Lake Winola and Lake Carey, while the main line will pass through Clark's Green, Waverly, Dalton and Factoryville, thence to Tunkhannock. The capital of the company is placed at $500,000, though it is expected that fully $1,000,000 will be expended on the undertaking. All the stock has been subscribed. Three power plants will be built—one in Scranton, one in Tunkhannock, and one at some intermediate point—and all buildings and roads are to be finished within one year.

INDUSTRIAL ITEMS.

THE COMMERCIAL ELECTRIC COMPANY, St. Louis, Mo., has secured the contract for the automatic police boxes for the World's Fair.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio, announces that on account of the unprecedented demand for its line of brass and iron steam specialties, it has been compelled to increase its foundry output fifty per cent. Machine tools of the most advanced type are now being installed in various departments as fast as they can be obtained.

MANHATTAN ELECTRICAL SUPPLY COMPANY, New York city, is issuing catalogue No. 15 descriptive of fans and accessories. This describes bracket, ceiling and desk electric fans for either alternating or direct current. The Manhattan company is sales agent for a number of prominent manufacturers and would be pleased to send literature on request.

THE WEBSTER, CAMP & LANE COMPANY, Akron, Ohio, manufacturer of turbine water wheels and hydraulic machinery, is meeting with continued success in the application of its special design horizontal turbine. The company has now installed forty-two penstock units in the 50,000 horse-power plant of the Michigan Lake Superior Power Company, at Sault Ste Marie, Mich.

JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is marketing a fine line of lumber pencils. These are made in black and colors and the company states these are first class as to quality of material and grade of color. These are packed one dozen in a box, six boxes in a carton. The new catalogue which the company has just issued describes these pencils and the company will be pleased to send this literature to any one interested.

A BOOK ON ADVERTISING—"Successful Advertising and How to Accomplish It"—has been written by J. Angus McDonald, and published by the Lincoln Publishing Company, Philadelphia. This volume contains hundreds of practical suggestions and illustrated methods which may be readily adapted by large and small advertisers. The plan of the work is more than ordinarily good, and those who spend either a few hundred dollars or many thousands of dollars yearly will find direct and quick aid to successful advertising plans.

MR. RAY D. LILLIBRIDGE has had occasion to again move his offices. This time, however, there is no change of address, the offices being moved upstairs to take a larger suite, the growing business of the technical advertising agency conducted by Mr. Lillibridge demanding more room. Mr. Lillibridge may be reached by two telephone communications—Nos. 5 and 975 Cortlandt, so that if one number is busy, it is likely that the other may be open for service. Mr. Lillibridge has recently made a number of important additions to his line of clients.

HENDERSON BROTHERS, general agents of the Anchor Line of transatlantic steamships, have published a souvenir booklet descriptive of tours in Ireland, Scotland and England. The book is handsomely printed on heavy white paper, the color effects being especially good. The mechanical preparation of the book, with regard to the selection of type, the press work on the half-tones, and the ink used, shows great care and fine judgment. The book is the product of the James Kempster Printing Company, New York city, and well maintains the reputation of that establishment for turning out high-class work.

THE MANUFACTURERS ADVERTISING BUREAU, New York city, was established over twenty years ago by its present proprietor, Mr. Benjamin R. Western, for many years publisher of technical journals in New York city. This bureau makes a specialty of managing the newspaper work and advertising of manufacturers, relieving them of the details of this most important end of business. A new pamphlet entitled "Advertising for Profit," giving information to manufacturers who seek business through the trade and technical journals, will be distributed on application at the bureau, 126 Liberty street.

MESSRS. SPON & CHAMBERLAIN, 123 Liberty street, New York city, have reprinted the schedules for dynamo design given in Dr. S. P. Thompson's recent book on the "Design of Dynamos." These schedules are printed on five sheets of heavy paper. The first contains schedules for the general description of the machine and the commercial test. The second and third sheets contain schedules for electrical, mechanical and magnetic details. The fourth sheet gives schedules for the calculation of armature windings and fields, and the fifth schedules for temperature tests and estimates of weights and costs. These sheets can be obtained from the publishers, and should be very useful to students and designers.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, 358 Dearborn street, Chicago, Ill., has just issued its catalogue No. 14. This catalogue lists a line of fuse strips and fuse links for electric lighting and power work, together with wire joints and many other items of this company's manufacture. The catalogue is printed on a green tinted paper, with a black and gilt cover, and is of a convenient size for pigeon holes. The company has endeavored to make this list very comprehensive, and has succeeded in condensing into a desirable form a great deal of information. The stock listed in this catalogue is now carried at the three offices of the company, in Chicago, Buffalo and New York. The catalogue will be sent to any one interested upon request.

H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, announces a heavy demand for "Vulcabeston" moulded union washers for Standard and Crane unions. These washers are made for all sizes of pipe, from one-quarter inch up to two and one-half inches, one-sixteenth-inch and one-eighth inch thick. These are ready for immediate application. Another familiar product of this company is "Vulcabeston" sheet packing, which is especially valuable for application in superheated steam work, and "Vulcabeston" rope packing for valve stems of radiators and heating apparatus. The company's lubricated valve stem packing for lubricators and injectors and small valve stems is designed especially for use on brass stems of all sorts. Samples and catalogue will be sent on application.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., has just printed bulletin No. 1, descriptive of telephone and switchboard apparatus for railway and interurban lines. The catalogue describes a good number of styles of central energy despatching telephones, cut-in jack and plug boxes for despatching systems, call bells for use with central energy despatching systems, pocket telephones, local battery central energy portable telephones, central energy office telephones, portable combination telephones, magneto despatching telephones, portable magneto despatching telephones, triple set hand generator and extension bell apparatus, bridging telephones, dry battery bridging telephones, portable desk telephones, magneto despatcher's switchboards, desk type despatcher's switchboards, protective apparatus, and terminal strips. In addition to this there are complete descriptions of railway despatching installations, showing the despatcher's card, and illustrated by handsome half-tone reproductions of actual service conditions. The catalogue is a handsome piece of work, the cover page being a bas-relief reproduction of a typical railway despatching station.

THE ALLIS-CHALMERS COMPANY, New York Life Building, La Salle and Monroe streets, Chicago, Ill., has just closed a contract for the exclusive right to manufacture and sell the Nurnberg gas engine. Mr. A. Rieppel, Koeniglicher Baurat, of Nurnberg, Germany, managing director of the Augsburg-Nurnberg Manufacturing Company, has recently visited the United States, and entered into an agreement with the Allis-Chalmers Company as mentioned above. Besides having the exclusive right to manufacture and sell the Nurnberg gas engine in the United States, the company has selling rights for many foreign countries, especially the Far East and South Africa. The Augsburg-Nurnberg Manufacturing Company, under the direction of Mr. Rieppel, has made a great success with these new gas engines, having, within the past few months, received orders for some 50,000 horse-power throughout Germany and Spain, chiefly for generating electric energy for blast furnace and spinning mill work. One of these engines now being built is for an important spinning mill in northern Germany, where the engine will be operated by producer gas. Mr. Rieppel is now on a tour of inspection throughout this country, after which he will visit the new and extensive works of the Allis-Chalmers Company, at West Allis, where these engines will be built.